Mattaponi River Watershed TMDL Implementation Plan

Prepared by

Virginia Department of Environmental Quality

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LIST OF ABBREVIATIONS

AOSS	Alternative Onsite Sewage Systems
AVMA	American Veterinary Medical Association
BMP	Best Management Practice
CBPA	Chesapeake Bay Preservation Act
CFR	Code of Federal Regulations
cfu	Colony Forming Units
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CWA	Clean Water Act
DCR	Virginia Department of Conservation and Recreation
DEQ	Virginia Department of Environmental Quality
DGIF	Department of Game and Inland Fisheries
DOE	Department of Education
DOF	Virginia Department of Forestry
EPA	United States Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
FSA	Farm Service Agency
FTE	Full Time Equivalent
FWS	United States Fish and Wildlife Service
GIS	Geographic Information System
GWRC	George Washington Regional Commission
HC-SWCD	Hanover-Caroline County Soil and Water Conservation District
HUC	Hydrologic Unit Code
JLARC	Joint Legislative Audit and Review Commission
LA	Load Allocation
LEF	Livestock Exclusion Fencing
MOS	Margin of Safety
MOU	Memorandum of Understanding
MPPDC	Middle Peninsula Planning and Development Commission
MPRA	Mattaponi & Pamunkey Rivers Association
MS4	Municipal Separate Storm Sewer System
NHD	National Hydrography Dataset
NLCD	National Land Cover Database
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NRCS	Natural Resources Conservation Service
SWCB	State Water Control Board
TCC-SWCD	Tri City/County Soil and Water Conservation District
TMDL	Total Maximum Daily Load
TR-SWCD	Three Rivers Soil and Water Conservation District
USDA	United States Department of Agriculture

USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VACS	Virginia Agricultural Cost Share
VCAP	Virginia Conservation Assistance Program
VCE	Virginia Cooperative Extension
VDH	Virginia Department of Health
VDOT	Virginia Department of Transportation
VGIN	Virginia Geographic Information Network
VLCD	Virginia Statewide Land Cover Dataset
VPA	Virginia Pollution Abatement
VPDES	Virginia Pollutant Discharge Elimination System
WIP	Watershed Implementation Plan
WLA	Wasteload Allocation
WQIF	Water Quality Improvement Fund
WQMIRA	Water Quality Monitoring, Information, and Restoration Act
WQMP	Water Quality Management Plans
WQS	Water Quality Standard
WRP	Wetland Reserve Program

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Caroline County
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Spotsylvania County
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Three Rivers Soil and Water Conservation District
Tri-County, City Soil and Water Conservation District
Virginia Department of Forestry
Virginia Department of Health
Lake Caroline Citizen's Association

Technical analysis and report production were completed by Streams Tech, Inc., through a contract with the Virginia Institute for Marine Sciences. Funding and oversight for the development of this plan were provided by the Virginia Department of Environmental Quality (DEQ), and DEQ staff drafted the report.

Executive Summary

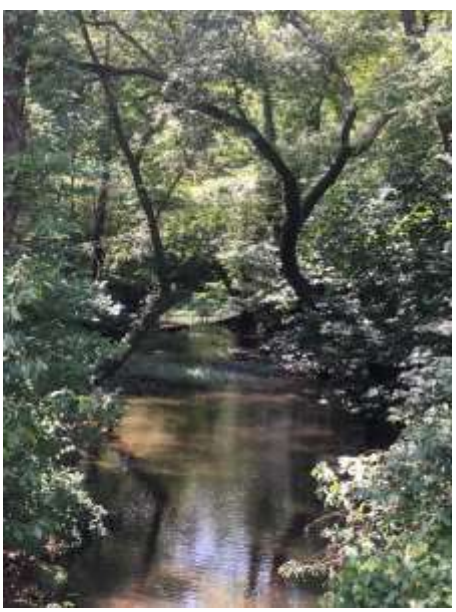
Overview

The plan contained in this report provides a detailed, multi-year framework to restore water quality in the Mattaponi River watershed planning area to healthy conditions. It describes current water quality status, identifies the bacteria reductions needed to achieve water quality goals, and summarizes a suite of management actions to restore water quality to attain those goals. The plan also summarizes the many programs, partners, and funding resources that can contribute to putting this plan into action.

The Mattaponi River and its tributaries are part of the York River basin; the implementation plan (IP) watershed covers over 630 square miles in Caroline, King and Queen, King William, Orange and Spotsylvania Counties, located south of Fredericksburg and north of Richmond, Virginia. The watershed is primarily rural in character, with forest and agricultural land uses predominant. More dense development is present in Spotsylvania County in the northwestern portion of the watershed, to the west of Interstate 95, where most population growth in the watershed is occurring.

While much of the Mattaponi River watershed is scenic in character, and most of its waterways have mature riparian areas that help protect water quality, there are several stream segments within the IP area that DEQ has designated as "impaired" relative to the water quality standards for recreational use due to excessive levels of *E. coli* bacteria. The first impaired waters within the IP area were reported to the Environmental Protection Agency (EPA) in 2002, and additional stream segments were included in subsequent impaired waters lists to the EPA through 2014, when a total of fifteen (15) stream segments in the IP area were identified as impaired due to excessive bacteria levels. Many of these are relatively small waterways, such as the Ni River shown in Figure ES-1 below. The impaired stream segments do not meet designated uses for primary contact recreation (e.g. swimming); in other words, coming in direct contact with the IP area waters could cause illnesses such as intestinal disorders.

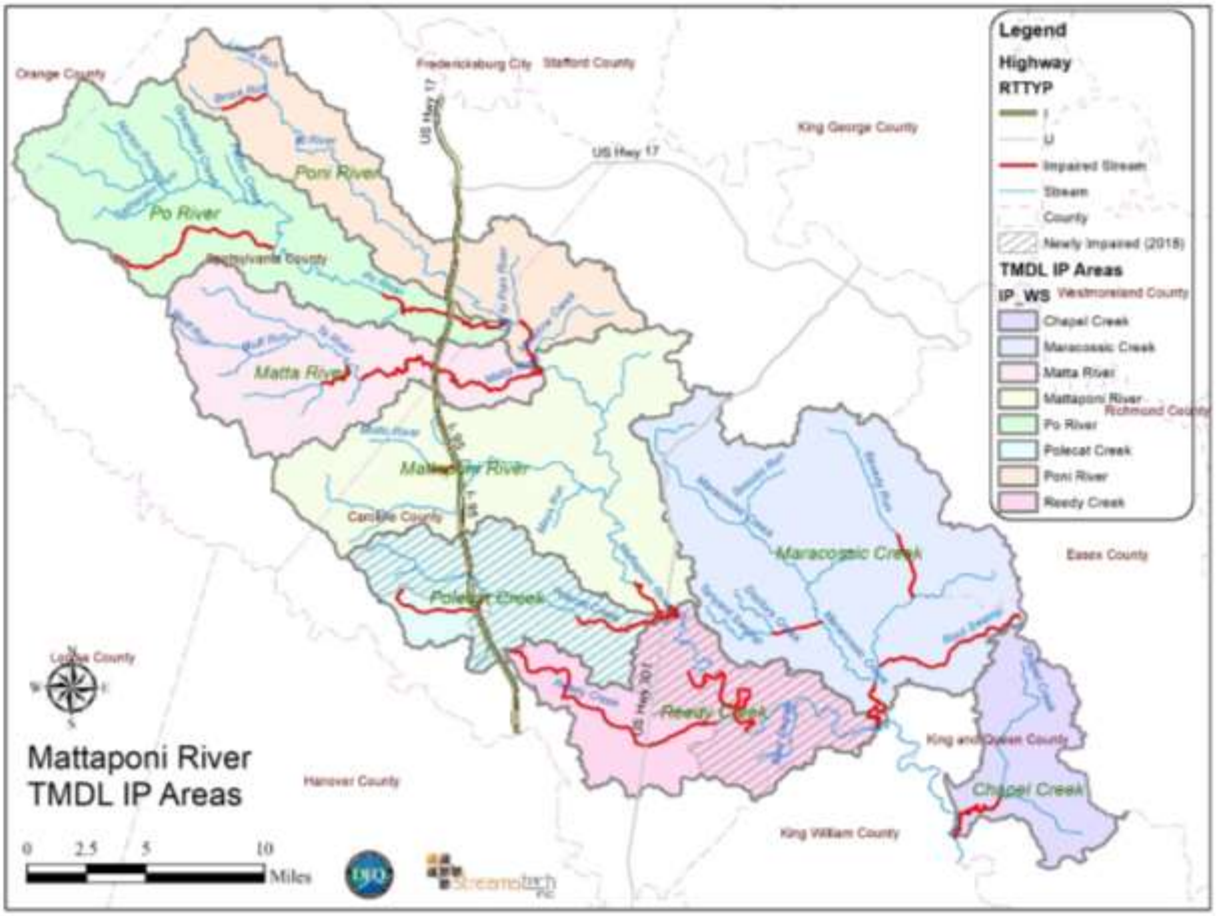
Figure ES-1: Ni River at Route 1 Bridge



The Virginia Department of Environmental Quality (DEQ) completed a Total Maximum Daily Load (TMDL) study in 2016 for fourteen (14) TMDL watersheds and set limits on the amount of bacteria each individual waterbody can receive and still support its designated recreational use standard. Additional stream segments were identified following the TMDL report, and those adjacent to the TMDL watersheds (including portions of Polecat Creek and the Mattaponi River) have been included in this plan. The Mattaponi River TMDL IP explains and quantifies the control measures, in the form of best management practices (BMPs), recommended over the next 15 years to reduce bacteria levels within the Mattaponi River IP watershed area shown in Figure ES-2 and enable the impaired waters to again meet recreational water quality standards.

The vast majority of bacteria reaching the Mattaponi IP watershed streams come from nonpoint sources, with the greatest share from agricultural lands. Only eleven (11) point sources are subject to a Virginia Pollutant Discharge Elimination System (VPDES) permit, and just ten additional domestic sewage general permits are active in the IP watershed. Point sources account for just one percent of the existing sources of bacteria in the Mattaponi IP watershed.

Figure ES-2. Mattaponi TMDL IP watersheds and impaired streams (Data Source: DEQ).



Review of the TMDL

The 2016 bacteria TMDLs called for elimination (100 percent reduction) of bacteria from failing septic systems and direct deposition from cattle into area streams. In addition, the TMDLs identified a need to reduce the bacteria loads carried by stormwater runoff from pastures, cropland and developed lands by a variable rate that would achieve the required bacteria reductions. The greatest reductions to runoff-based bacteria sources were required in the Root Swamp TMDL watershed, at 80 percent, and the Maracossic and Reedy Creek TMDL watersheds required the least runoff-based reductions, at 18 percent each.

To identify the bacteria reductions needed in the areas of Polecat Creek and the Mattaponi River that were not a part of the 2016 TMDL, model calculations were prepared using the methodology of the 2016 TMDLs for the newly impaired areas. Also, to simplify the presentation of this plan, the fourteen (14) original TMDL watersheds and the newly impaired areas were combined based on their hydrologic drainage patterns into the eight IP watersheds shown in Figure ES-2.

DEQ analyzed the most recent water quality monitoring data to identify current conditions in the plan area and assess how bacteria levels varied by changes in water flow regime. Where excessive bacteria levels were only detected during higher flow regimes, runoff-based sources are the likely cause. When exceedances of the bacteria criterion occur during low flows, direct deposition of bacteria from cattle in streams or straight pipe sewage discharges may be present. This analysis can help to inform plan implementation efforts to identify and address individual sources of bacteria in the years ahead.

The DEQ (and EPA) expectation for TMDL IPs is to achieve bacteria reductions that will result in no exceedance of the geometric mean criterion value, and less than a 10.5 percent exceedance rate of the maximum assessment criterion (the water quality criteria are explained in Section 8 of the report). These water quality end-points fully achieve the Commonwealth of Virginia's recreational use water quality standard in effect as of September 1, 2019. Virginia is in the process of revising its recreational water quality standards and assessment protocols, and future listing and delisting of impaired waters will be in accord with the standards and protocols in place at the time future impairment decisions are made.

Public Participation

Local stakeholders were broadly informed of the need for an implementation plan in July 24 and July 31, 2018 initial public meetings, and agricultural and residential workgroups subsequently formed and met to provide input on how best to address bacteria contamination in the Mattaponi IP watershed. Workgroup participants provided essential local knowledge throughout the IP development process.

A Steering Committee comprised of selected workgroup members from local government agencies and local citizens and agricultural producers provided valuable feedback on this draft plan during its March 27, 2019 meeting. DEQ held a final public meeting to present the draft plan on September 10, 2019. A 30-day public comment period followed this meeting to seek additional public input to enable DEQ to further clarify and refine the plan, as needed, before submitting it for final approvals. No additional public comments were provided to DEQ during the final public comment period.

Recommended Management Measures

The bacteria reductions needed to achieve the water quality standards for bacteria are spread across the agricultural, residential septic, and developed land sectors. A broad suite of best management practice actions are recommended to address sources of bacteria and ultimately restore the recreational use of the IP area's waters. In summary, these actions include:

- 119 additional miles of livestock exclusion fencing, with riparian buffers, at an estimated cost of $3.5 million.
- 27,831 acres of pasture and cropland improvements, and sediment retention structures addressing drainage for nearly 3,461 acres, at an estimated cost of $5.2 million.
- 706 acres of targeted conversion of pasture/cropland to forest or permanent vegetative cover, for steep slope land and critical stream habitat areas (these costs are included in pasture/cropland).
- 18 individual equine manure composting systems, and 20 barnyard runoff control systems for horse farms, at an estimated cost of $234 thousand.
- Extensive residential septic system improvements, including 14,611 septic pump-outs, 2,083 repairs, 80 system replacements, and 47 public sewer system hookups, costing $16.4 million.

- Stormwater management projects, including rain gardens, riparian buffers and wetlands restoration, to treat runoff from 4,595 acres of developed lands at an estimated cost of $5.6 million.
- Pet waste disposal stations and composter/digesters estimated to cost $731 thousand.
- A comprehensive 15-year education, outreach and technical assistance program, costing approximately $1.4 million.

Benefits

The direct benefit of the actions called for in this plan will be restoration of water quality to meet standards for recreational use of the area's streams. These water quality benefits also contribute to improving the quality of downstream waters of the Mattaponi and York Rivers, and the Chesapeake Bay. This plan's actions will provide additional benefits of enhanced agricultural productivity, livestock health, and aquatic habitat within the watershed. Residential septic improvements will reduce the incidence of higher cost system failures; improved stormwater management can reduce local flooding; and better pet waste management will improve community aesthetics.

The plan's recommended actions are proposed to be put into place over a 15-year timeframe. Strong local leadership, and support from both state and federal government agencies and a multitude of local stakeholders will be critical for success. An approved implementation plan will increase opportunities for local agencies and watershed residents to obtain funding to support their installation of the recommended BMPs. Sustained actions consistent with the recommendations of this plan are projected to enable the delisting of all impaired waters of the IP watershed by the year 2034.

1 Introduction

The Virginia Total Maximum Daily Load (TMDL) program is designed to improve water quality and restore impaired waters in Virginia. A TMDL identifies the maximum amount of a pollutant that a water body can receive without surpassing the state water quality standards. These standards are established to protect six beneficial uses: drinking water, recreational (i.e., primary contact/ swimming), fishing, shellfishing, aquatic life, and wildlife. If the water body exceeds the water quality criteria used to measure the standard during an assessment period, Section 303(d) of the Clean Water Act (CWA) and EPA's Water Quality Management and Planning Regulation (40 CFR Part 130) both require states to develop a TMDL for each pollutant contributing to its impairment.

The Mattaponi River and its tributaries are part of the York River basin. The York River basin extends nearly 220 miles from its mouth to the Chesapeake Bay, and lies within the central and eastern section of Virginia. The York basin is comprised of York River, which is just 30 miles in length, and its two major tributaries, the Pamunkey and the Mattaponi Rivers. The Mattaponi River watershed addressed in this Implementation Plan (IP) covers over 406,332 acres in Caroline, King and Queen, King William, Orange, and Spotsylvania counties between Richmond and Fredericksburg, Virginia, as shown in Figure 1-1**.**

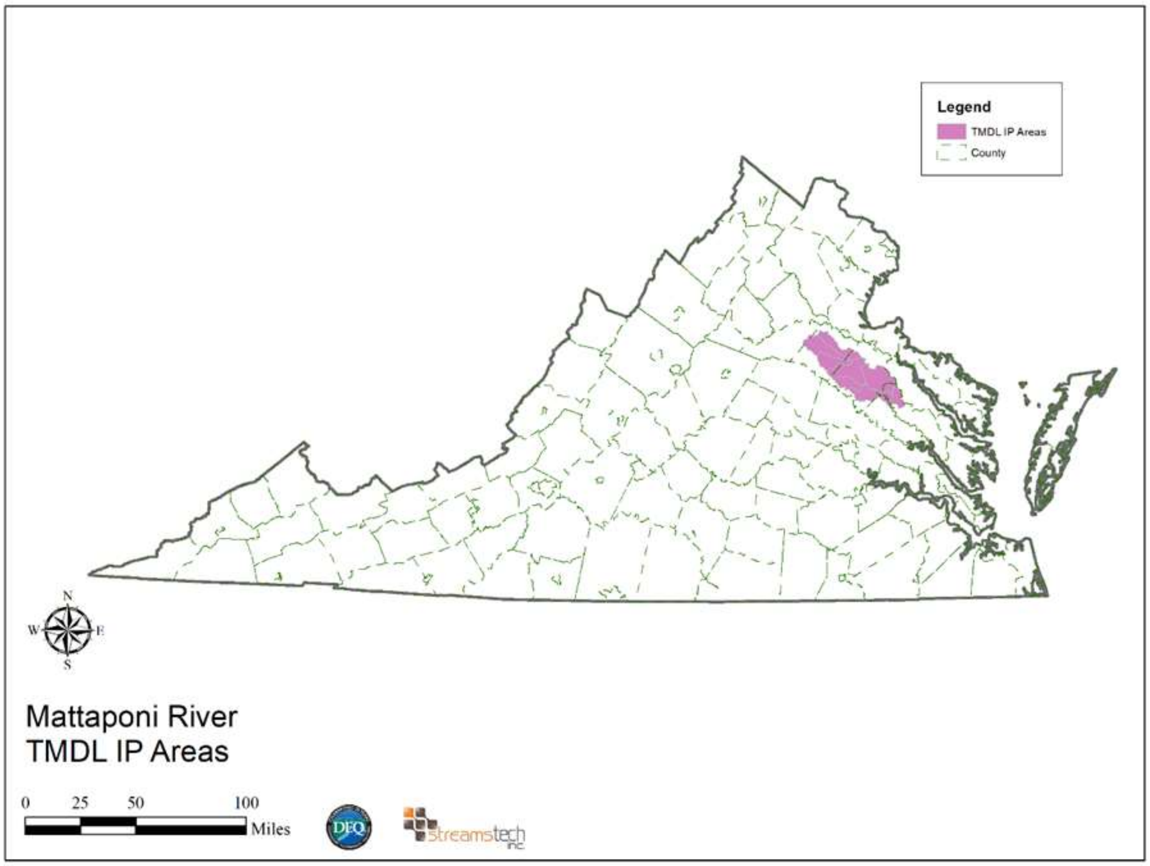


Figure 1-1: Location of Mattaponi River IP watershed in northern Virginia

The headwaters of the project area, in Spotsylvania and Orange Counties, are entirely within the Piedmont ecoregion. The Chapel Creek, Maracossic Creek, and Reedy Creek/Mattaponi River IP watersheds are completely within the Southeastern Plains ecoregion. The Matta River, Mattaponi River, Po River, Polecat Creek, and Poni River IP watersheds straddle the two ecoregions. The Southeastern Plains ecoregion historically included much bottomland forested wetlands, though historic drainage activities have considerably reduced the extent of wetlands in this part of the project area. The Piedmont ecoregion originally supported Oak-Hickory-Pine Forest, which also has been altered by settlement.

Most of the watershed lies within Caroline and Spotsylvania Counties. While much of the watershed is primarily rural in character (Figure 1-2), with forest (65%) and agricultural (17%) land uses predominant, more dense development is present in the northwestern portion of the watershed in Spotsylvania County. Population growth in Spotsylvania County has been rapid, with a 7.6% increase to 135,100 people from 2010-2017, however most of the IP watershed is much less developed. Caroline County, which is similar in size to Spotsylvania, has a population of less than 30,000 and King and Queen County's population is under 10,000. The total population of the Mattaponi IP watershed is about 55,000 and the population density of 87 people per square mile is less than half the average population density in Virginia.

Figure 1-2: Beef cattle in the Mattaponi watershed. Photo by Jim Tate, 2018

The initial recreational use impairments within the IP Area were listed on Virginia's 2004 Virginia Water Quality Assessment 305(b)/303(d) Integrated Report due to exceedances of the State's water quality standard for fecal coliform bacteria. These included portions of Reedy Creek in the southern portion of the watershed and the Matta River in the western section/upper reaches of the watershed. The impaired stream segments did not meet designated uses for primary contact recreation (e.g. swimming). By the time of the TMDL study in 2013, a total of fourteen (14) stream segments in the Mattaponi Watershed were included on the Virginia Impaired Waters list, which are as shown in Figure 1-3.

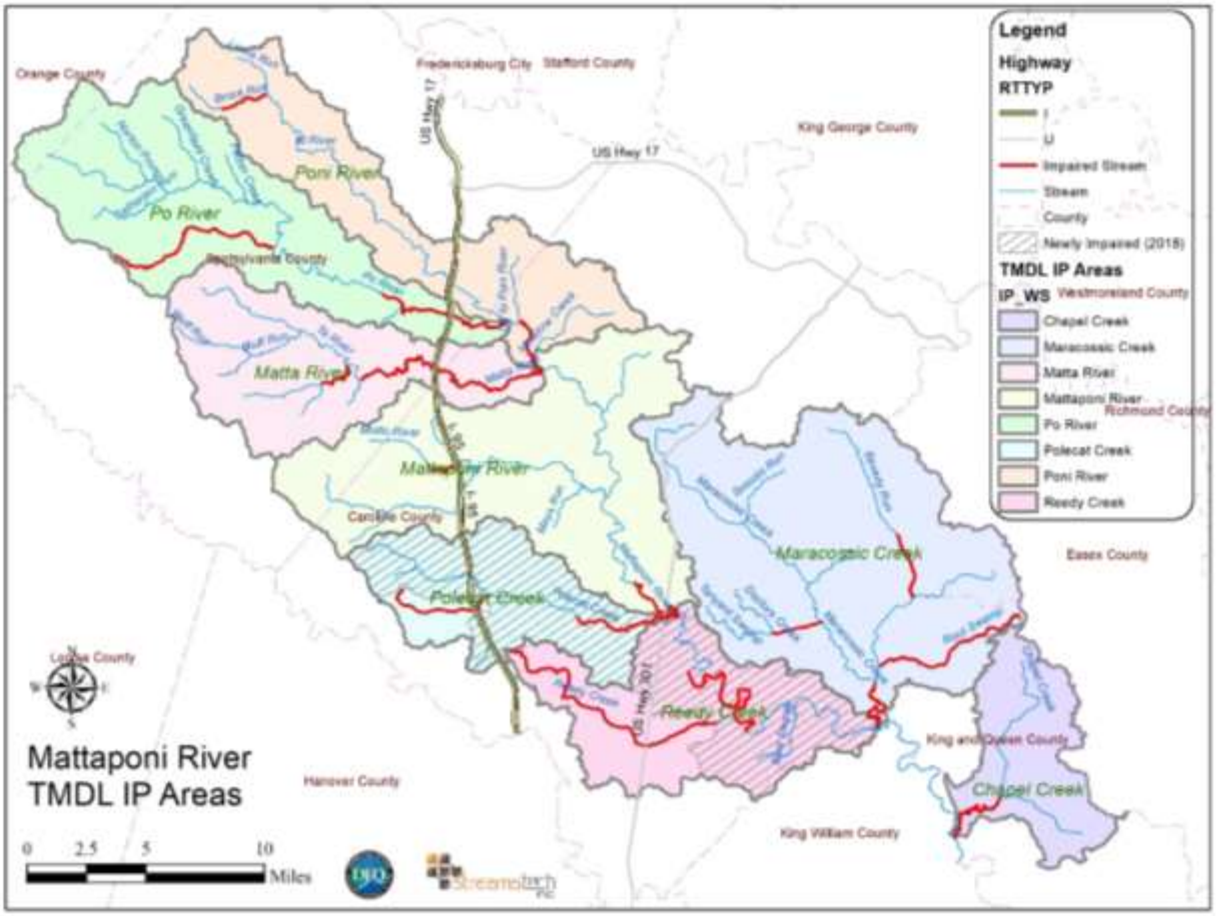


Figure 1-3: The impaired streams in the Mattaponi River IP project area (Data Source: DEQ)

DEQ completed a TMDL study for the Mattaponi watershed that identified bacteria sources in each sub-watershed and set limits on the amount of bacteria these waterbodies can receive and still support their designated recreational use standard. The 2016 Bacteria TMDL report for the Mattaponi River Watershed identifies the bacteria reductions needed within each of the fourteen TMDL watersheds (shown in map above). It assigned bacteria reduction allocations to the following sources: developed land, pasture, hay, cropland, cattle direct deposition, and failing septic systems. All identified impairments in the Mattaponi River watershed are addressed by this plan.

Following completion of the TMDL report in 2016, additional recreational use impaired segments were identified within some of the TMDL watersheds, and new impairments were identified in 2018 within areas contiguous to the 2016 TMDL watersheds (see the areas in above map with hatched lines). The additional impairments within the 2016 TMDL watersheds reported in the 2016 Virginia "Integrated Report", and the new 2018 impairments along the Mattaponi River mainstem and on Polecat Creek are also addressed in this IP.

This report explains and quantifies actions needed to reduce bacteria levels to meet water quality standards and allow a delisting of the impaired waters from the Section 303(d) List. The IP describes control measures, commonly called best management practices (BMPs), to be implemented in a staged process over the next 15 years. Local support and successful implementation of the plan will result in the restoration of the impaired waters of the Mattaponi River Watershed and enhancement of the natural resource values of the watershed more broadly. An approved IP will increase opportunities for the counties, area Soil and Water Conservation Districts (SWCDs), other local organizations, and watershed residents to obtain funding to support installation of the recommended BMPs.

This technical document can be obtained at: http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL/TMDLImplementation/TMDLImplementationPlans.aspx, accessed 5/17/2019.

2 Federal and State Requirements

Both state and federal requirements and recommendations were followed in developing this plan. The development of an IP is a requirement of Virginia's 1997 Water Quality Monitoring, Information, and Restoration Act (§62.1-44.19:4 through 19:8 of the Code of Virginia), or WQMIRA (DEQ 1997). WQMIRA directs the State Water Control Board (SWCB) to "develop and implement a plan to achieve fully supporting status for impaired waters."

In order for IPs to be approved by the Commonwealth, they must meet the following requirements of WQMIRA:

- date of expected achievement of water quality objectives,
- measurable goals,
- necessary corrective actions, and
- associated costs, benefits, and environmental impact of addressing the impairment

EPA regulations (40 CFR 130.33(b)(10)) require the inclusion of an implementation plan as an element of TMDL submittal. The EPA minimum elements of an approvable IP are described in EPA's 1999 Guidance for Water Quality-Based Decisions: The TMDL Process, and include:

- a description of the implementation actions and management measures,
- a time line for implementing these measures,
- legal or regulatory controls,
- the time required to attain water quality standards, and
- a monitoring plan and milestones for attaining water quality standards.

The IP for the Mattaponi River watershed fully addresses both the EPA and Virginia requirements and recommendations for TMDL implementation plans.

2.1 Requirements for Section 319 Funding Eligibility

The EPA has developed guidelines that describe the process and criteria used to award CWA Section 319 nonpoint source grants to States. The "Nonpoint Source Program and Grants Guidelines for State and Territories" (April, 2013) continues long-standing emphasis on the following nine elements for meeting Section 319 program requirements:

1. Identify the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in the watershed-based plan;

2. Estimate the load reductions expected to achieve water quality standards;

3. Describe the nonpoint source (NPS) management measures that will need to be implemented to achieve the identified load reductions;

4. Estimate the amount of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement the watershed-based plan.

5. Provide an information/education component that will be used to enhance public understanding of the project and encourage the public's participation in selecting, designing, and implementing NPS management measures;
6. Provide a schedule for implementing the NPS management measures identified in the watershed-based plan;
7. Describe interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented;
8. Identify a set of criteria for determining if loading reductions are being achieved and if progress is being made towards attaining water quality standards; if not, identify the criteria for determining if the watershed-based plan needs to be revised; and
9. Establish a monitoring component to evaluate the effectiveness of implementation efforts.

Once complete, DEQ presents IPs to the State Water Control Board (SWCB) for delegated approval to guide efforts to implement pollutant allocations and reductions contained in the TMDL. DEQ also requests inclusion of new IPs in the appropriate Water Quality Management Plan (WQMP), in accordance with CWA Sec. 303(e) and Virginia's Public Participation Guidelines for Water Quality Management Planning.

3 Mattaponi River Watershed TMDL Review and Update

3.1 Overview

Water quality samples collected by DEQ from 2002 through 2014 at fifteen (15) monitoring stations along the Mattaponi River and its tributaries demonstrated impairments due to high bacteria levels. Matta River and Reedy Creek locations had fecal coliform bacteria concentrations in violation of Virginia's maximum assessment criterion of 1,000 colony forming units (cfu)/100 milliliters (mL) more than 10 percent of the time and were first listed as impaired in the 2004 Water Quality Assessment Integrated Report. Brock Run, Chapel Creek, Doctors Creek, Glady Run, Maracossic Creek, Mat River, Mattaponi River, Motto River, Po River, Polecat Creek, Poni River, and Root Swamp locations had concentrations of *E. coli* bacteria exceeding 235 cfu/100 mL more than 10 percent of the time. This value is referred to as the maximum assessment criterion.

Due to the water quality conditions, all of these waters were included in Virginia's 2014 305(b)/303(d) Water Quality Assessment Integrated Report as impaired due to *E. coli* bacteria concentrations that do not meet the state's water quality criteria for the recreational designated use. In 2016, bacteria TMDLs were approved by the EPA for the fourteen impaired waterbodies in the Mattaponi River watershed (DEQ 2016a). Beverly Run, which is a tributary to Maracossic Creek, was also added to the Virginia's 2016 305(b)/303(d) Water Quality Assessment Integrated Report (IR) for not meeting the bacteria standards and additional segments within the IP project area are proposed for inclusion in the 2018 IR Report.

The 2016 TMDLs quantified the amount of *E. coli* bacteria the streams can receive without exceeding water quality standards, and the associated reductions necessary to achieve this result. TMDLs do not include a description of how, specifically and practically, the necessary bacteria reductions can be achieved. It is the purpose of the Mattaponi River IP to develop a stakeholder-driven, practical, and implementable plan to meet water quality standards.

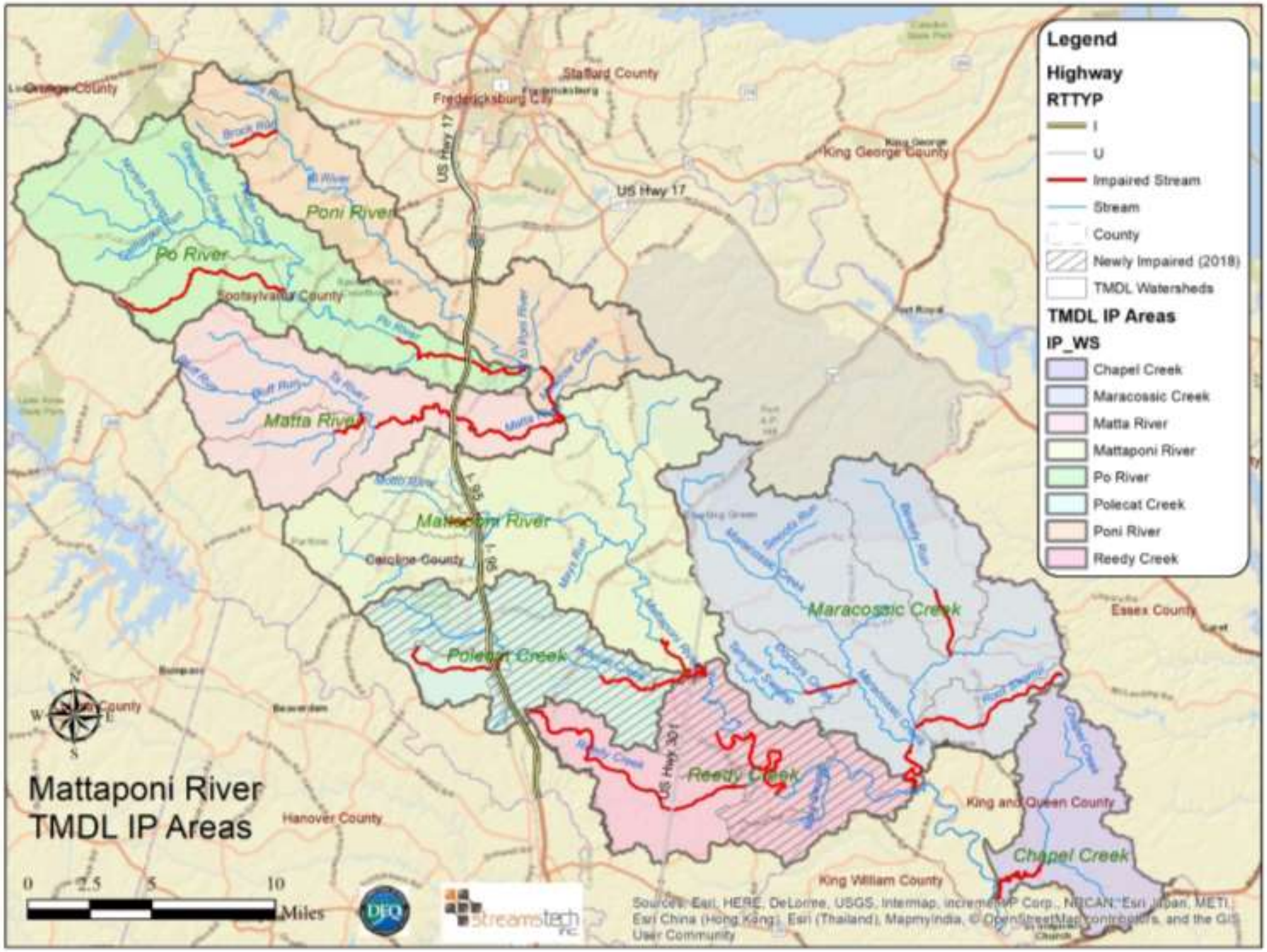
A plan for the successful implementation of the Mattaponi River TMDLs requires a re-evaluation of watershed conditions to ensure that water quality criteria will be met as a result of implementation. This section presents a review and update of the Mattaponi River TMDLs. Namely, the study area is described in Section 3.2, land use is discussed in Section 3.3, source assessment in Section 3.4, water quality conditions in Section 3.5, and modeling updates in Section 3.6.

3.2 Study Area

The Mattaponi watershed is located within the York River basin, in the Piedmont and Coastal Plain geologic zones. The area has a mixed-humid climate, with average annual precipitation of 40 inches. Average summer low and high temperatures are 68 to 88 degrees Fahrenheit and average winter low and high temperatures are 27 to 48 degrees Fahrenheit. Soils are predominantly sandy loam with moderately fine to moderately coarse textures (hydrologic soil group B) across the IP project area. A detailed description of soils, geology, and climate in the Mattaponi River watershed is provided in the TMDL Report (DEQ, 2016a).

The geographic area of the IP includes the upper portion of the Mattaponi River watershed including the Brock Run, Poni River, Glady Run, Po River, Mat River, Matta River, Motto River, Mattaponi River, Polecat Creek, Reedy Creek, Beverly Run, Doctors Creek, Root Swamp, Maracossic Creek and Chapel Creek watersheds. The fourteen (14) TMDL watersheds were regrouped into eight IP watersheds by folding smaller TMDL watersheds into the larger TMDL watersheds through which they drained. This was done to reduce the complexity of presenting the final IP to the public. Figure 3-1 shows a map of the eight IP watersheds and impaired stream segments.

Figure 3-1: Mattaponi River IP watershed boundaries and impaired stream segments.



Note that the Polecat Creek and Reedy Creek IP boundaries are different from the Polecat Creek and Reedy Creek TMDL watershed boundaries used in the 2016 TMDL Report. In Figure 3-1, the original TMDL watersheds for Polecat and Reedy Creek are color-coded and the adjacent cross-hatched area of the same color is the area with new (2018) impairments added to the adjoining TMDL watershed. The Polecat Creek IP area includes the entire drainage area of Polecat Creek and its tributaries located upstream of its confluence with Mattaponi River. The Polecat Creek TMDL watershed is a small part of the corresponding IP area. Similarly, the Reedy Creek TMDL watershed is a small part of the Reedy Creek IP area, which includes the entire drainage area of Reedy Creek as well as the drainage area of an adjacent Mattaponi River segment. The drainage area of the Mattaponi River segment is the same as DEQ's 6th order HUC YO50.

Data and analyses are presented in this chapter according to the IP watersheds, each of which group one or more of the fourteen (14) TMDL watersheds. Table 3-1 lists the IP watersheds, TMDL watersheds and impaired segments within each IP area. Table 3-2 presents the distribution of IP watersheds by county.

Table 3-1: IP watersheds, TMDL Watersheds, and Impaired Stream Segments.

IP Watershed	TMDL Watershed	Cause Group Code	Impaired Stream Segment	HUC12	6th Order Virginia NWBD Code
Poni River	Brock Run	F15R-02-BAC	VAN-F15R_BRK01A06	020801050101	YO38
	Poni River	F17R-03-BAC	VAN-F17R_PNI01A10	020801050101, 020801050105	YO38,YO42
Po River	Glady Run	F16R-02-BAC	VAN-F16R_GDY01A10	020801050103	YO40
	Po River	F16R-01-BAC	VAN-F16R_POR01A10	020801050102, 020801050104	YO39,YO41
Matta River	Mat River	F18R-03-BAC	VAN-F18R_MAT01A12	020801050201	YO43
	Matta River	F18R-02-BAC	VAN-F18R_MTA01A00	020801050202, 020801050203	YO44,YO45
Mattaponi River	Motto River	F19R-02-BAC	VAN-F19R_MOT01A04	020801050204	YO46
	Mattaponi River	F17R-02-BAC	VAN-F17R_MPN01A02	020801050204, 020801050205	YO46,YO47
Polecat Creek	Polecat Creek	F20R-02-BAC	VAN-F20R_PCT02A02	020801050301	YO48
	Polecat Creek*	F20R-03-BAC	VAN-F20R_PCT01A00	020801050301	YO48
Reedy Creek	Reedy Creek	F21R-03-BAC	VAN-F21R_RDY02A10	020801050302	YO49
	Reedy Creek	F21R-03-BAC	VAN-F21R_RDY02B10	020801050302	YO49
	Mattaponi River*	F21R-07-BAC	VAN-F21R_MPN02A02	020801050204, 020801050205	YO46,YO47

Maracossic Creek	Beverly Run*	F22R-04-BAC	VAN-F22R_BEV01B00	020801050402	YO52
	Doctors Creek	F22R-02-BAC	VAN-F22R_DOC01A08	020801050403	YO53
	Root Swamp	F22R-03-BAC	VAN-F22R_ROT01A06	020801050402	YO52
	Maracossic Creek	F22R-01-BAC	VAN-F22R_MAR01A02	020801050401, 020801050402, 020801050403	YO51,YO52,YO53
Chapel Creek	Chapel Creek	F21R-04-BAC	VAN-F21R_CPL01A06	020801050501	YO54

* These watersheds pertain to impairments identified in 2016 and 2018 and were not included in the 2016 TMDL report.

Table 3-2: Distribution of IP project area by county.

County	IP Area	Area (acres)
Caroline County	Maracossic Creek	75,015
	Matta River	5,741
	Mattaponi River	64,835
	Po River	823
	Polecat Creek	31,487
	Poni River	11,847
	Reedy Creek	38,877
	Total	**228,625**
Essex County	Chapel Creek	43
	Maracossic Creek	124
	Total	**167**
King and Queen County	Chapel Creek	23,725
	Maracossic Creek	12,585
	Total	**36,310**
King William County	Reedy Creek	3,777
	Total	**3,777**
Orange County	Po River	3,235
	Total	**3,235**
Spotsylvania County	Matta River	36,126
	Mattaponi River	8,114
	Po River	55,206
	Poni River	34,902
	Total	**134,348**
	Grand Total	**406,462**

3.3 Land Use

The bacteria TMDLs for the Mattaponi River watershed utilized land cover/land use data from the 2011 National Land Cover Database (NLCD) (Homer et al. 2015). Since the 2011 NLCD data is the latest land cover/land use data available, no revision to the land use data is necessary. However, as noted above, the Polecat Creek and Reedy Creek IP watersheds are much larger than the TMDL watersheds due to incorporation of the areas adjacent to new impaired stream segments that are included in the draft 2018 integrated report. Accordingly, the land use distribution for these two IP watersheds differs from the corresponding 2016 TMDL watersheds. See Appendix A for more details on the revised land use distribution. The land use distribution in individual IP watersheds is summarized in Table 3-3 and illustrated in Figure 3-2. The areas consist primarily of forested lands (ranges from 61.5% to 68%). Water/wetlands, pasture and cropland make up most of the remaining areas. Developed lands represent less than 2% of land use in each of the eight IP watersheds, with the highest amount of developed lands being in the northwest portion of the IP project area, near Interstate 95 and south of Fredericksburg. This area continues to experience higher growth rates than other portions of the Mattaponi watershed.

Table 3-3: Distribution of land use acreage and percent of total area by IP watershed

IP Watershed	Unit	Barren Land	Cropland	Dev High Intensity	Dev. Low Intensity	Dev. Med. Intensity	Dev. Open Space	Forest	Hay	Pasture	Water/ Wetland	Total
Chapel Creek	Acres	5.4	3,427.2	-	32.0	5.2	617.2	15,320.0	59.3	2,516.9	1,773.3	**23,757**
	% of Total	0.02%	14.43%	0.00%	0.13%	0.02%	2.60%	64.49%	0.25%	10.59%	7.46%	**100%**
Maracossic Creek	Acres	134.5	7,999.1	21.6	442.1	153.0	3,816.3	58,892.0	377.5	8,301.3	7,545.0	**87,682**
	% of Total	0.15%	9.12%	0.02%	0.50%	0.17%	4.35%	67.17%	0.43%	9.47%	8.60%	**100%**
Matta River	Acres	110.1	2,272.2	7.6	192.7	107.1	2,058.9	28,464.0	1,253.4	3,322.1	4,060.9	**41,849**
	% of Total	0.26%	5.43%	0.02%	0.46%	0.26%	4.92%	68.02%	3.00%	7.94%	9.70%	**100%**
Mattaponi River	Acres	236.3	6,056.7	50.6	826.1	368.7	4,685.4	44,844.3	1,170.9	4,018.7	10,658.5	**72,916**
	% of Total	0.32%	8.31%	0.07%	1.13%	0.51%	6.43%	61.50%	1.61%	5.51%	14.62%	**100%**
Po River	Acres	75.9	2,971.4	23.5	381.9	166.6	4,326.5	38,138.0	2,153.5	4,715.1	6,305.2	**59,258**
	% of Total	0.13%	5.01%	0.04%	0.64%	0.28%	7.30%	64.36%	3.63%	7.96%	10.64%	**100%**
Polecat Creek	Acres	74.2	2,436.4	35.3	599.1	226.1	2,252.5	20,277.4	217.8	2,336.2	3,031.8	**31,487**
	% of Total	0.24%	7.74%	0.11%	1.90%	0.72%	7.15%	64.40%	0.69%	7.42%	9.63%	**100%**
Poni River	Acres	303.9	2,163.7	30.2	634.6	248.5	4,192.2	29,160.9	1,210.3	2,729.2	6,054.8	**46,728**
	% of Total	0.65%	4.63%	0.06%	1.36%	0.53%	8.97%	62.41%	2.59%	5.84%	12.96%	**100%**
Reedy Creek	Acres	252.2	3,455.5	12.4	145.5	89.7	1,750.4	26,927.6	199.0	3,325.6	6,496.7	**42,655**
	% of Total	0.59%	8.10%	0.03%	0.34%	0.21%	4.10%	63.13%	0.47%	7.80%	15.23%	**100%**
Total	**Acres**	**1,193**	**30,782**	**181**	**3,254**	**1,365**	**23,699**	**262,024**	**6,642**	**31,265**	**45,926**	**406,331**
	%	**0.3%**	**7.6%**	**0.04%**	**0.8%**	**0.3%**	**5.8%**	**64.5%**	**1.6%**	**7.7%**	**11.3%**	**100%**

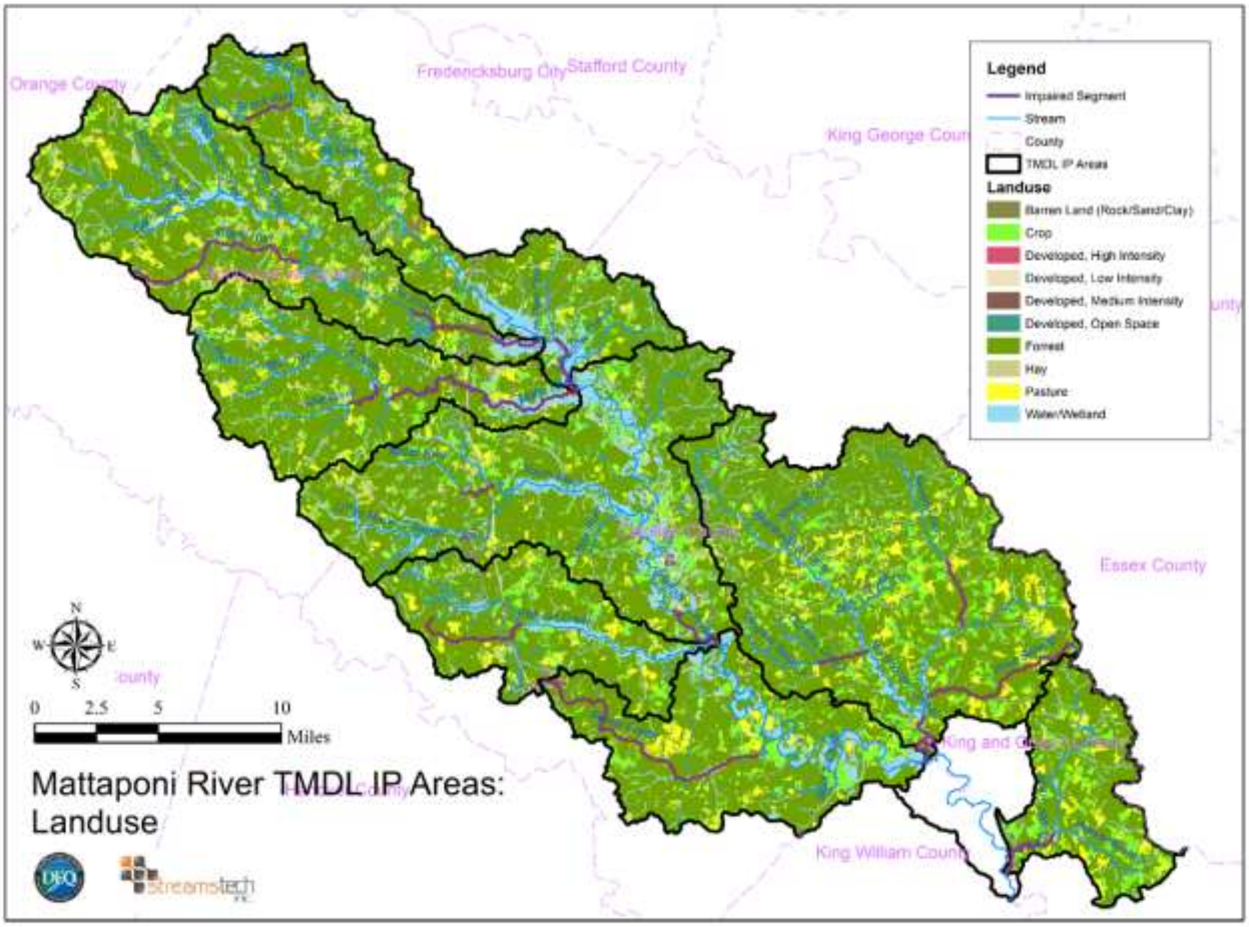


Figure 3-2: Land use distribution in individual IP watersheds.

3.4 Source Assessment

The 2016 TMDL report (DEQ 2016a) included a source assessment to identify potential human, agricultural, domestic, and wildlife sources of bacteria in the Mattaponi River watershed. This section provides summaries of information provided in the TMDL report and updated information for septic systems (Section 3.4.3) and livestock (Section 3.4.4). Except for the Polecat Creek and Reedy Creek IP watersheds, the data used in the TMDL Report for population and number of households (Section 3.4.1), point sources (Section 3.4.2), wildlife (Section 3.4.5), pets (Section 3.4.6), and biosolids (Section 3.4.7) remained unchanged in developing the IP. Data for the Polecat Creek and Reedy Creek watersheds were revised to cover the areas of the IP watersheds that were not included in the 2016 TMDL watersheds.

3.4.1 Population and Number of Households

The county-level population estimates for the years 2010 and 2013 were obtained from the U.S. Census Bureau (US Census Bureau, 2014). Table 3-4 shows the data for each county falling partly within the project area and includes the percentages of changes in the population within each county. Each county shows a slight increase in population in the three-year period. Similarly, Table 3-5 outlines the U.S. Census Bureau housing unit data for the years 2010 and 2013 for each of the counties in the project area.

Table 3-4: County-level populations for each county located in the IP watershed area.

Statistic	Caroline County	King and Queen County	King William County	Orange County	Spotsylvania County
Population, 2010	28,545	6,945	15,935	33,481	122,397
Population, 2013 estimate	29,285	7,118	16,103	34,623	127,696
Population, percent change, April 1, 2010 to July 1, 2013	2.5%	2.5%	1.1%	3.6%	4.1%

Table 3-5: Total number of housing units for each county located within the IP watershed area.

Statistic	Caroline County	King and Queen County	King William County	Orange County	Spotsylvania County
Housing Unit, 2010	11,729	3,414	6,522	14,616	45,185
Housing Unit, 2013 estimate	11,892	3,425	6,607	14,779	45,749
Housing Unit, percent change, April 1, 2010 to July 1, 2013	1.39%	0.32%	1.30%	1.12%	1.25%

More refined Census Block level population and housing data are available for 2010, but not for 2013. The 2010 population and number of housing units for each TMDL watershed were calculated by summing up the data that are specific to only the Census Blocks located within the watershed. These numbers were then projected for the year 2013, using the percentage changes reported in Table 3-4 and Table 3-5. These population estimates and the number of housing units at the TMDL watershed level were aggregated to determine the population and number of housing units in each IP area as shown in Figure 3-3.

The population and number of housing units in the Polecat Creek and Reedy Creek IP watersheds that are outside their 2016 TMDL watersheds were estimated using the same approach and then combined with the values of the TMDL watersheds.

Table 3-6: Estimated population and numbers of housing units in the IP watersheds

IP Area	Population	Number of Houses
Chapel Creek	1,007	439
Maracossic Creek	4,011	1,741
Matta River	5,423	1,963
Mattaponi River	10,602	4,176
Po River	11,045	4,045
Polecat Creek	4,105	1,909
Poni River	13,928	4,685
Reedy Creek	5,501	2,236
Total	**55,622**	**18,958**

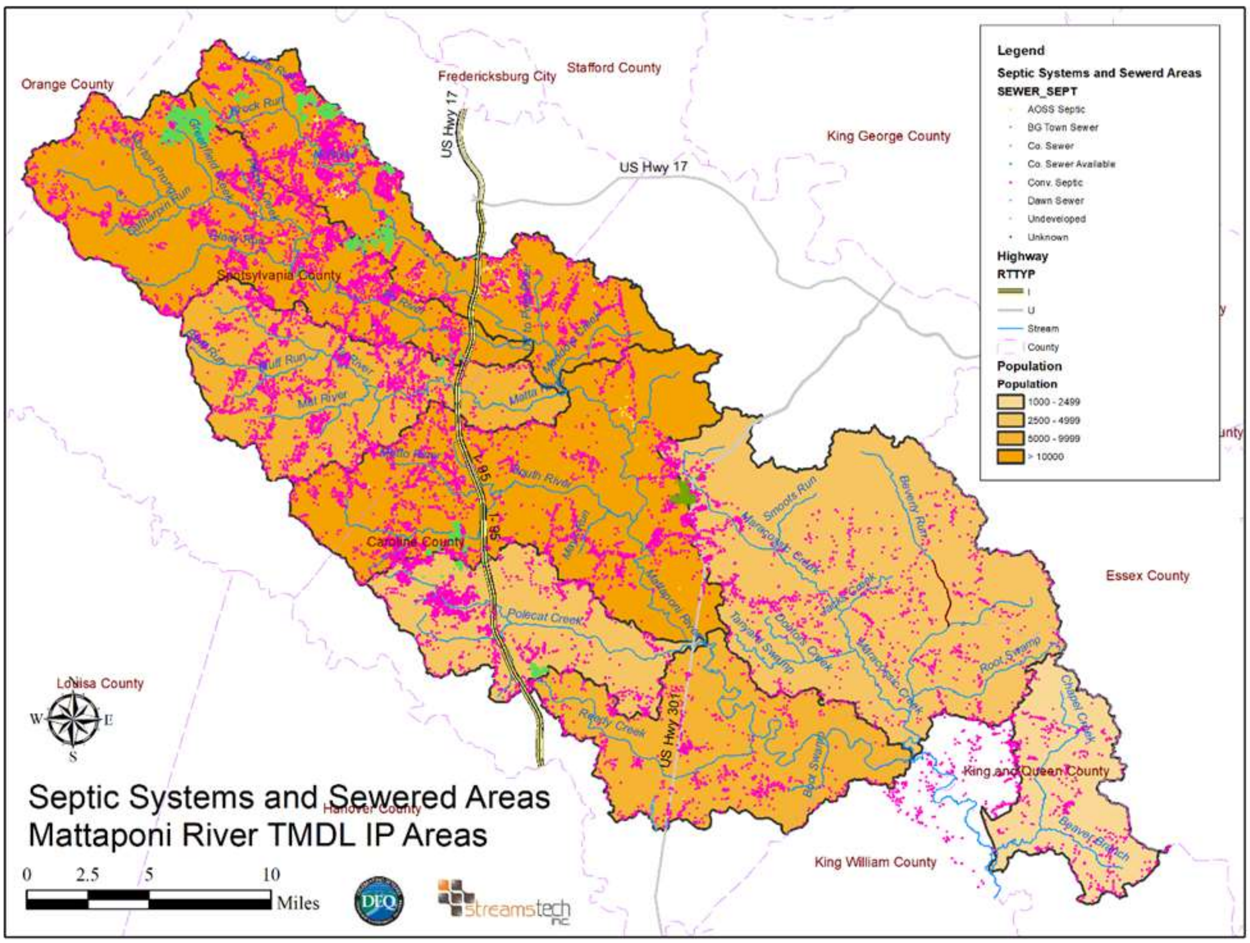


Figure 3-3: Estimated 2013 population by IP watershed with sewer and septic service areas shown.

3.4.2 Point Sources

As documented in the 2016 TMDL report, most bacteria in the Mattaponi watershed comes from nonpoint sources. Point sources are estimated to contribute between 0.0% and 1.76% of existing bacteria loads. The individual permitted facilities and general domestic permitted facilities that are within the IP area are discussed below.

3.4.2.1 Individual Permitted Facilities

The discharge of pollutants from facilities is permitted through Virginia's Pollutant Discharge Elimination System (VPDES) individual permits. There are currently 11 municipal facilities with active individual permits that are expected to discharge the contaminant of concern (bacteria) within the project area; 10 of these facilities discharge within IP watersheds and the Caroline County Regional WWTP facility discharges to an unimpaired segment of Polecat Creek. Caroline County Regional WWTP is categorized as major and all other facilities are categorized as minor (they discharge less than 1.0 million gallons per day) facilities. All permitted facilities are required to meet water quality criteria for bacteria at their discharge point(s). Table 3-7 outlines the permit discharge limits and some pertinent information for the applicable permits within the IP watersheds and Figure 3-4 illustrates the locations of the 11 permits. The data for the VPDES permitted facilities were obtained from DEQ.

Table 3-7: Applicable facilities with active VPDES individual permits that discharge within IP watersheds

County	IP Watershed	Receiving Stream	River Mile	Permit No.	Facility Name	Design Flow (MGD)
Caroline	Maracossic Creek	Maracossic Creek, UT	4.21	VA0090689	Hill Mobile Home Park Sewage Treatment Plant 2	0.005
Caroline	Polecat Creek	Polecat Creek	5.31	VA0073504	Caroline County Regional WWTP	1.50
Caroline	Mattaponi River	Mattaponi River, UT	3.2	VA0020737	Bowling Green Wastewater Treatment Plant	0.25
Caroline	Mattaponi River	South River, UT	3.2	VA0060887	Lake Land ‘Or Utility	0.22
Caroline	Mattaponi River	Motto River, UT	3.2	VA0061409	Woodford Estates MHC Limited Liability Corp.	0.040
Spotsylvania	Matta River	Mat River, UT	2.3	VA0061301	Berkeley Elementary School	0.0053
Spotsylvania	Matta River	Ta River	11.89	VA0087271	Spotsylvania County High School	0.028
Spotsylvania	Poni River	Po River, UT	7.21	VA0029513	Thornburg Community Sewage Treatment Plant	0.345
Spotsylvania	Poni River	Po River	7.21	VA0029769	Po River Water and Sewer WWTP	0.1
Spotsylvania	Poni River	Po River, UT	7.21	VA0061298	John J Wright Educational and Cultural Center	0.015
Spotsylvania	Poni River	Ni River, UT	3.21	VA0091014	Dominion Campground Incorporated	0.01

3.4.2.2 General Domestic Permitted Facilities

In Virginia, any owner of a domestic sewage treatment system with a design flow of less than or equal to 1,000 gallons per day on a monthly average basis must register for the VPDES domestic sewage discharge general permits for single-family homes. Ten systems are currently authorized within the project area to discharge under this general permit and were incorporated in the TMDLs. Table 3-8 lists the 10 domestic sewage discharge general permits and Figure 3-4 illustrates their location within the IP watersheds.

Table 3-8: Active VPDES Domestic Sewage Discharge General Permits in the IP watersheds

County	IP Watershed	Receiving Stream	Permit No
Caroline	Poni River	Meadow Creek, UT	VAG406563
Spotsylvania	Matta River	Glebe Run	VAG406432
		Ta River, UT	VAG406545
		Matta River, UT	VAG406557
	Mattaponi River	Motto River, UT	VAG406130
		Motto River, UT	VAG406515
	Poni River	Po River, UT	VAG406173
		Wrights Pond, UT	VAG406416
		Ni River, UT	VAG406396
		Spring Creek	VAG406560

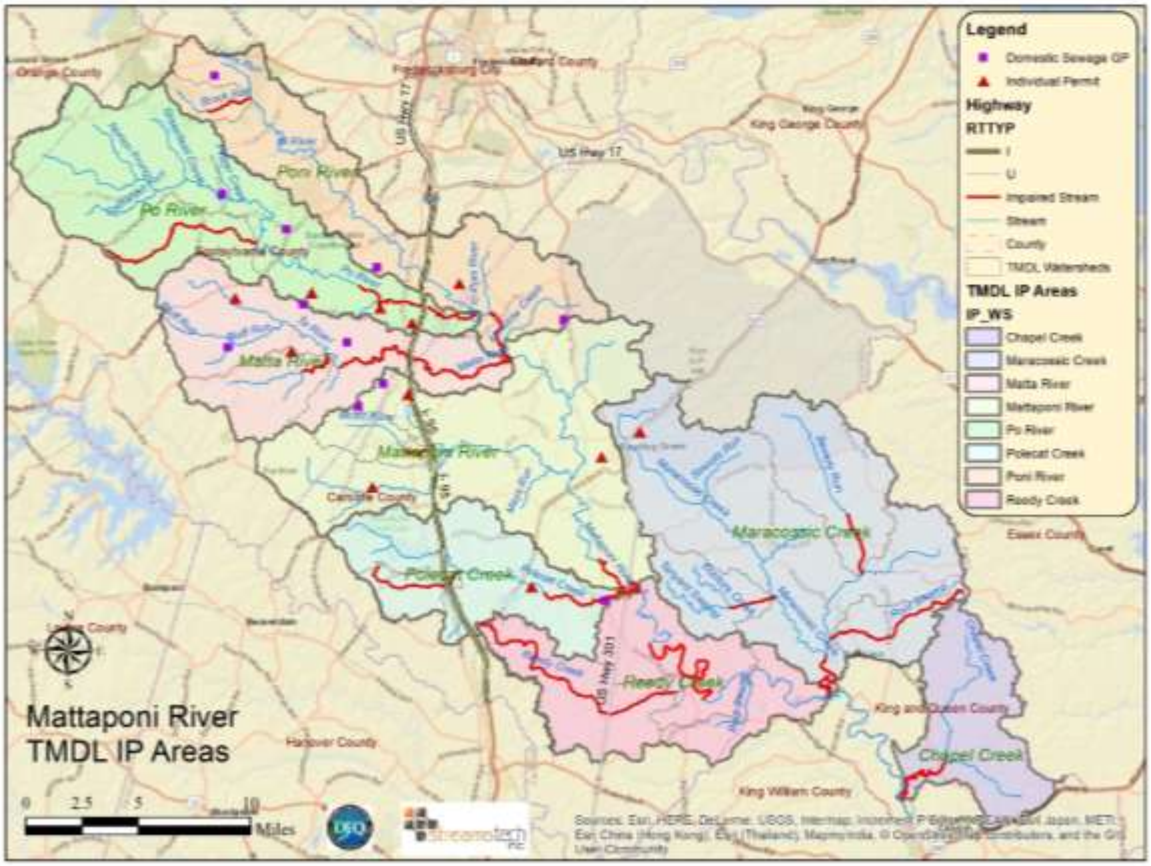


Figure 3-4: VPDES individual and domestic sewage discharge general permit locations in the IP area.

3.4.2.3 MS4 Permits

During development of the TMDL, there was one Municipal Separate Storm Sewer System (MS4) general permit under which Virginia Department of Transportation (VDOT) (Permit No. VAR040115) was authorized for portions of the 2010 U.S. Census-defined Fredericksburg Urbanized area that overlap Spotsylvania County within the Poni River IP watershed (HUCs 020801050101 and 020801050104). Since then, all MS4 general permits under which VDOT had authorization were consolidated into one individual permit that provides coverage statewide. Therefore, there is now one MS4 individual permit (Permit No. VA0092975) in the IP project area.

3.4.3 Septic Systems

During development of this IP, DEQ became aware of a septic system analysis that was more detailed than that included in the 2016 TMDL report. In 2018, Kevin F. Byrnes of Regional Decision Systems, L.L.C. collected and analyzed septic and sewer system data from Virginia Department of Health (VDH) and local governments to inform development of the George Washington Regional Commission's (GWRC) proposed BMP projections for local jurisdictions as input to Phase III of the Chesapeake Bay TMDL Watershed Implementation Plan (WIP). Mr. Byrnes subsequently provided DEQ the Geographic Information System (GIS) data of the septic systems and homes with sewer connections in the Mattaponi IP watersheds to enable more precise septic system BMP recommendations.

The box below discusses the methodology used in the 2018 septic system analysis.

The following steps and assumptions were used in developing the GIS data:

1. The master address list was extracted from VGIN's address point file released October 1, 2018.
2. For locations in Spotsylvania and Caroline counties, the "Sewer Septic" field was populated based on public records provided by the respective jurisdiction. If the address was not found in local reference files, the value "Unknown" was inserted.
3. The value "AOSS Septic" = Alternative Onsite Sewage System as reported in the VDH VENIS system for filed O&M reports. "Conv. Septic" refers to a standard septic system.
4. For the locations in Orange, Essex, King & Queen and King William, all locations were assumed to be on "Conv. Septic".
5. Other than census-related attributes, additional data fields (e.g. Year Built, Septic Permit Year, Sq. Footage, Building Assessed Value, etc.) in King & Queen and King William county portions of the IP watersheds were blank, as the county real estate assessment files in these two cases could not be accessed to pull the information.
6. The customer address list for the Bowling Green Town sewer system could not obtained. Therefore, all addresses in the Town were assumed to be connected and specific addresses (identified by Co. GIS staff) on the Town's outskirts were tagged as connected to the Town system as well.

The original data were later grouped into four categories: Standard Septic Systems, Alternative Onsite Sewage System, Sewer and Unknown. When local soil conditions do not support the installation of standard or conventional septic system, additional treatment must be added to the system design to compensate for the lack of suitable soils and the treatment they provide. These systems are called Alternative Onsite Sewage Systems.

Residential wastewater systems located in the IP project area are summarized in Figure 3-5 and details are presented in Table 3-9. Table 3-10 shows each type of system as a percentage of total number of systems in the IP area. The septic system age was calculated based on the installation year of septic system, when available. However, for many homes the year the septic system was installed was not known. Table 3-11 provides a summary of the age of the septic systems, with the assumption that for those systems without a known installation year, the age of the system is the same age as the home that it services.

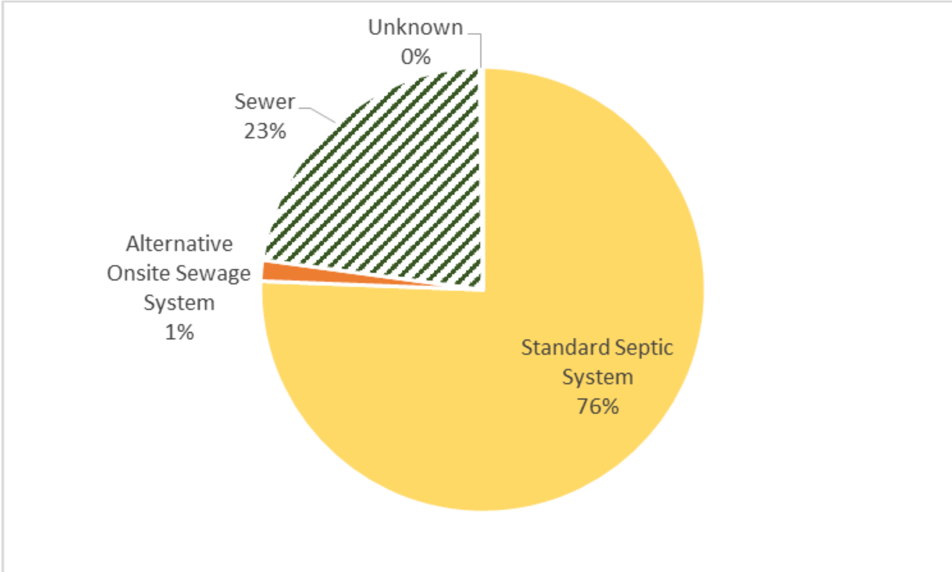


Figure 3-5: Distribution of residential wastewater systems by type in the IP area.

Table 3-9: The number and type of residential wastewater systems in each IP Watershed

Type of System	Chapel Creek	Maracossic Creek	Matta River	Mattaponi River	Po River	Polecat Creek	Poni River	Reedy Creek	Total
Total No. Systems	440	1,946	2,152	4,347	4,575	2,307	5,157	1,021	**21,945**
Standard Septic System	440	1,673	2,072	3,204	3,326	1,718	3,185	977	**16,595**
Alternative Onsite Sewage System		15	24	61	39	16	174	6	**335**
Sewer	-	258	47	1,081	1,175	573	1,791	38	**4,963**
Unknown	-	-	9	1	35	-	7	-	**52**

Table 3-10: Sanitary waste disposal system as a percent of total in each Mattaponi River IP Watershed

Type of System	Chapel Creek	Maracossic Creek	Matta River	Mattaponi River	Po River	Polecat Creek	Poni River	Reedy Creek	Total
Standard Septic System	100.0%	86.0%	96.3%	73.7%	72.7%	74.5%	61.8%	95.7%	**75.6%**
Alternative Onsite Sewage System	0.0%	0.8%	1.1%	1.4%	0.9%	0.7%	3.4%	0.6%	**1.5%**
Sewer	0.0%	13.3%	2.2%	24.9%	25.7%	24.8%	34.7%	3.7%	**22.6%**
Unknown	0.0%	0.0%	0.4%	0.0%	0.8%	0.0%	0.1%	0.0%	**0.2%**
Total									**100.0%**

Table 3-11: The age distribution of the septic systems

Age in 2018	Chapel Creek	Maracossic Creek	Matta River	Mattaponi River	Po River	Polecat Creek	Poni River	Reedy Creek	Total
0 to 20 years	0.0%	22.8%	39.7%	28.0%	33.7%	23.1%	37.2%	33.1%	**31.6%**
21 to 40 years	0.2%	28.3%	33.1%	29.8%	34.0%	25.2%	33.4%	31.2%	**30.9%**
41 to 60 years	0.0%	13.5%	11.5%	18.9%	11.8%	25.9%	11.9%	16.0%	**13.6%**
> 60 years	0.0%	9.3%	3.5%	9.5%	3.4%	10.0%	4.5%	9.6%	**5.9%**
Unknown	99.8%	26.0%	12.3%	13.9%	17.1%	15.9%	13.0%	10.0%	**18.0%**
Total									**100.0%**

3.4.4 Livestock

Livestock estimates were obtained from the local SWCDs as part of the development of the Mattaponi River TMDLs. The 2007 and 2012 U.S. Department of Agriculture (USDA) Agricultural Census data were used as the initial source of the livestock population in each county and later adjusted based on input from local NRCS and Tri-County/City SWCD (TCC-SWCD) staff (NRCS, 2015 and TCC-SWCD, 2015). As stated in the TMDL Report (DEQ, 2016a) local conservation specialists suggested that the Agricultural Census cow inventory numbers were high and should be reduced. Therefore, the Agriculture Census data were reduced by 50%. The livestock population in each TMDL watershed was calculated based on the distribution of pasture land and the livestock population in each county. Except for Polecat Creek and Reedy Creek IP watersheds, the livestock numbers were calculated by aggregating the livestock counts in the TMDL watersheds within each IP watershed. The livestock numbers in Polecat Creek and Reedy Creek IP watersheds were computed using the same approach employed to estimate the numbers in each TMDL watershed. The estimated livestock population in each IP watershed is shown in Table 3-12.

Table 3-12: Estimated livestock populations within the IP watersheds

IP Watershed	Beef Cows	Milk Cows	Goats	Hogs and Pigs	Horses and Ponies	Sheep and Lambs	Chicken
Chapel Creek	17	5	8	-	72	6	35
Maracossic Creek	202	1	82	17	284	37	544
Matta River	274	8	18	34	195	9	402
Mattaponi River	148	1	40	16	160	18	335
Po River	431	13	22	53	281	11	581
Polecat Creek	84	-	88	4	34	15	58
Poni River	211	6	18	26	151	8	317
Reedy Creek	75	7	83	9	31	13	54
Grand Total	**1,335**	**34**	**209**	**152**	**1,209**	**98**	**2,357**

This section uses the summary livestock data and GIS analyses to estimate the livestock exclusion/stream fencing BMP requirements in the Mattaponi River IP watersheds. Three different methods were applied to identify the potential locations and amount of livestock exclusion fences needed along pasture and hay lands that border with area streams. The methods used different combinations of stream network and land use selections to identify the streams and locations along them that are most appropriate for stream fencing. Different approaches allowed DEQ to assess the effects of varied analytical approaches, and discuss the results with local stakeholders. The assumptions, steps involved in processing GIS data and outcomes of each of these methods are discussed below.

Method 1:

The National Hydrography Dataset (NHD), which provides the most detailed GIS data of the perennial stream network was the foundation of this analysis. It was assumed that any NHD perennial stream crossing pasture or hay lands would require stream fencing. Fencing would be provided on one or two sides of a stream segment, depending the location of pasture or hay lands. The specific steps used in this analysis were as follows:

- The Virginia Department of Conservation and Recreation (DCR) recommends that stream fencing be placed 35 feet away from streams. A line GIS data set was created at 35 feet away from the NHD flowline GIS data (Figure 3-6) using the buffer creation tool in ArcMap.
- This buffer line data were intersected with pasture and hay land uses. Only the segments of the buffer lines within the pasture or hay areas were assumed to be the potential locations of fencing and saved as a GIS data set.
- The length of each fence was calculated in ArcMap and the total length of fencing was 104 miles. Figure 3-7 shows the locations of potential stream fences along NHD streams. Most of

the identified fencing needs were located along the small streams of the NHD flowline data set.

- Smaller NHD streams include channels that are just 1 or 2 feet wide. These streams are so narrow that, as a practical matter, a cow would not be able to stand and defecate in the water. Livestock access to these streams is unlikely to cause significant bacterial pollution. In contrast, livestock exclusion fencing would be very effective in case of larger streams (e.g. > 10 ft wide). Therefore, it was decided that the potential fencing sites along only major streams should be determined.

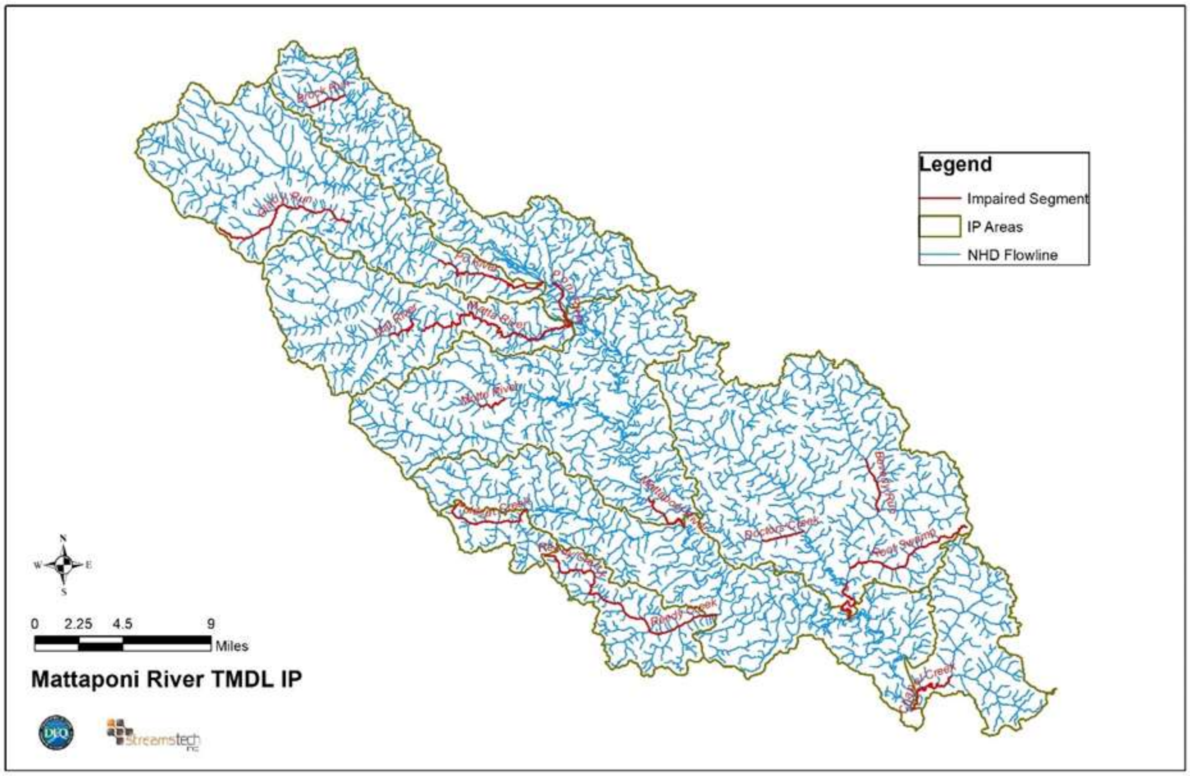


Figure 3-6: Stream network based on the National Hydrography Datatset (NHD) flowline GIS data

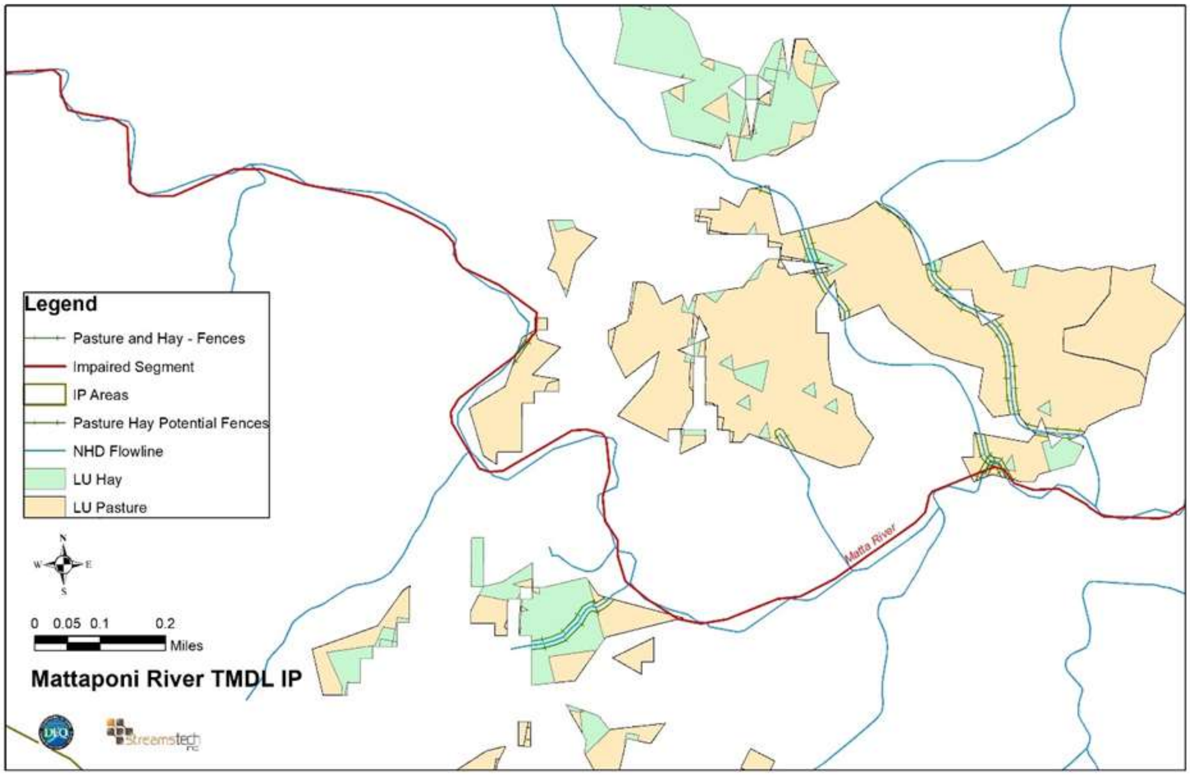


Figure 3-7: Potential stream fencing locations along NHD streams that cross pasture and hay lands

Method 2:

In order to determine the potential livestock fencing locations along the major streams, the steps described in Method 1 were followed using the stream network from the TMDL model instead of NHD, which is shown in Figure 3-8. The total fencing requirement estimated using this method was less than 2 miles. This estimate seemed very low considering the length of streams and extent of pasture and hay areas in the IP watersheds.

A review of stream centerline and land use data revealed that water/wetland land use is commonly located along the major streams. In these cases, the stream segments are contained within the boundary of water/wetland land use polygons (see Figure 3-9), and as a result, the stream network often do not intersect with adjacent pasture and hay lands. A different approach, as discussed in Method 3 below, was developed to correct the problem and provide a better estimate of the potential fencing needs and locations.

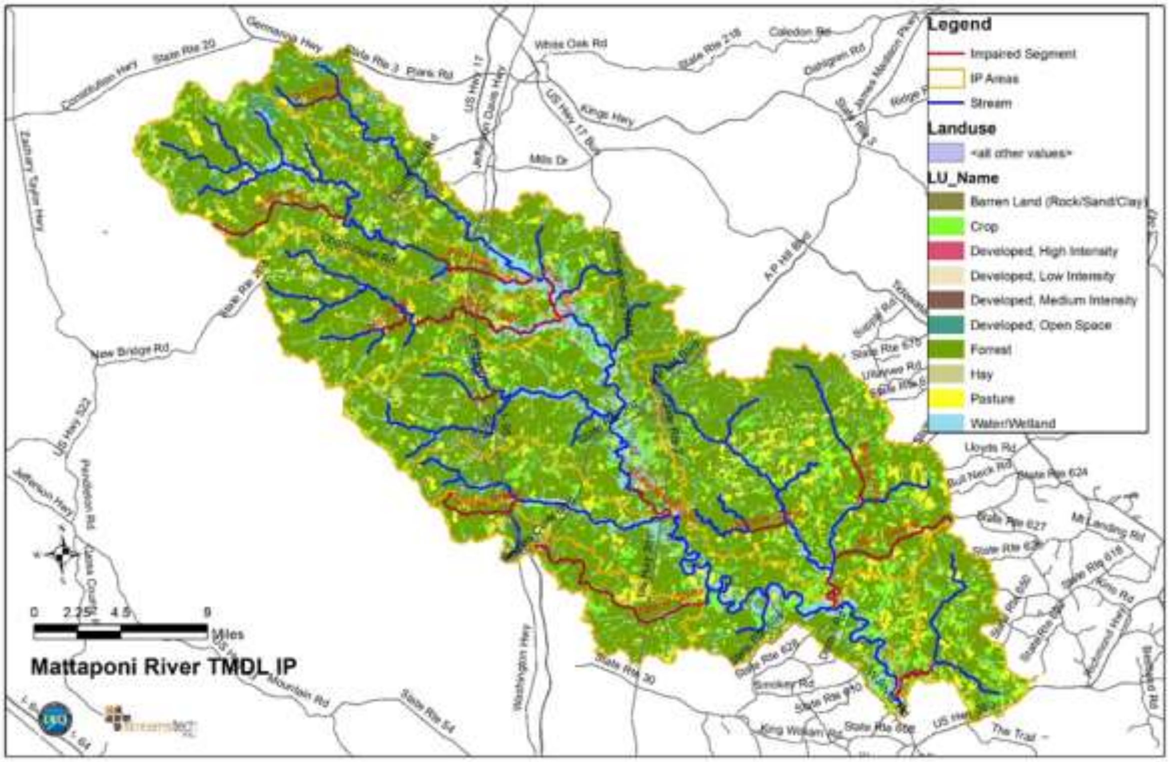


Figure 3-8: Major stream reaches in the Mattaponi River watershed used to develop the bacteria TMDLs

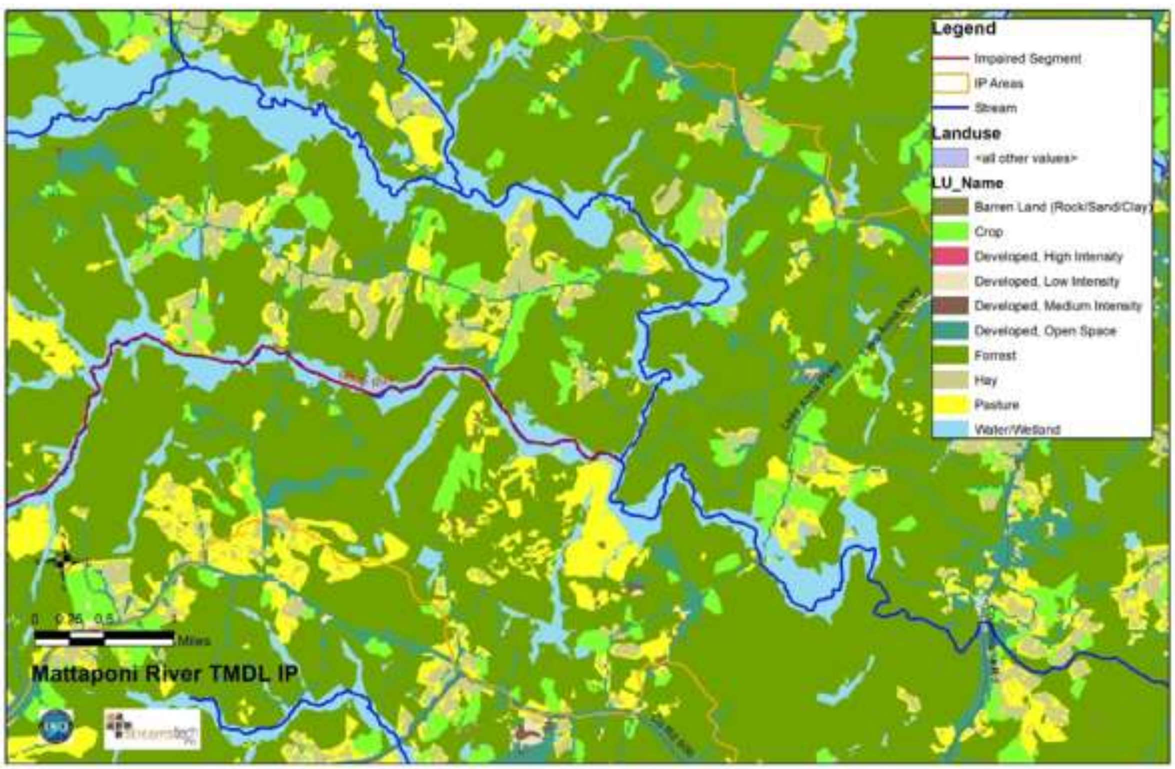


Figure 3-9: Many major stream segments are contained in the water/wetland land use polygons

Method 3:

The detailed land use classes in the 2011 NLCD were reclassified into 10 summary classes to develop the bacteria TMDLs in the Mattaponi River watersheds. These land use classes include water/wetland, pasture and hay. Assuming that the areas bordering between water/wetland and pasture or hay are the potential sites for livestock exclusion fences, a GIS analysis was performed to identify such borders. ArcMap tools were used to draw lines at interfaces between water/wetland and pasture or hay land uses. Figure 3-10 shows the potential fencing location and land uses in a small area to view the outcome of this method. Method 3 resulted in a total length of potential fencing in IP watersheds of 124 miles.

The results of the three stream fencing analysis methods were presented and discussed with the Agricultural Workgroup, who agreed with DEQ that Method 3 was the most appropriate approach to estimate IP project area fencing needs. This GIS analysis provides a detailed objective starting point for identifying priority areas for landowner outreach for stream fencing opportunities during plan implementation. The local SWCDs have begun to look at large-scale aerial photo images of the plan area to identify locations currently used for livestock grazing. Together with local knowledge of the agricultural sector, the GIS analysis presented above will help to uncover the best opportunities to reduce bacteria from livestock direct deposition to area streams.

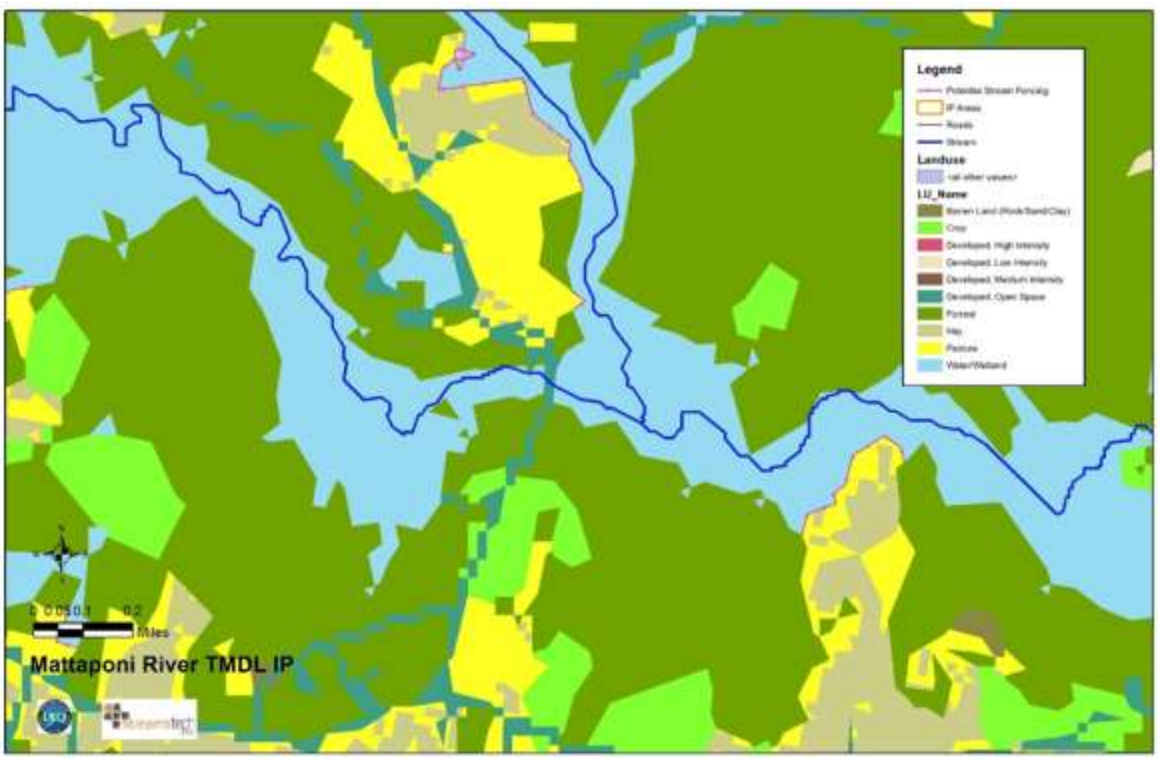


Figure 3-10: Potential stream fencing sites along borders between water/wetland and pasture or hay land uses.

3.4.5 Wildlife

The wildlife in a TMDL watershed is potentially a significant source of bacteria. An inventory of wildlife population in the project area was conducted using the data and information presented in previous

Virginia TMDL reports approved by EPA, especially the *E. coli* TMDL Development for The Pamunkey River and Tributaries, VA (DEQ, 2004), recommendations of the local Virginia Department of Game and Inland Fisheries personnel, and the suitable habitat areas in the Mattaponi River watershed. The suitable habitat areas within the project area were determined based on the land use and hydrography data. Table 3-13 provides a list of suitable habitats and typical wildlife densities by species. The estimated wildlife counts in the IP watersheds are presented in Table 3-14 and the daily production rate of fecal coliform for each wildlife type is provided in Table 3-15.

Table 3-13: Wildlife habitats and typical densities

Species	Suitable Habitat	Typical Population Density
Deer	Whole watershed except open water, high intensity development	0.0344 animals/acre[1]
Raccoon	Within 600 feet of streams and ponds	0.07 animals/acre[1]
Muskrat	Within 66 feet of streams and ponds	2.75 animals/acre[1]
Beaver	Within 66 feet of streams and ponds	4.8 animals/mile of stream[1]
Goose	Whole Watershed	0.02 animals/acre[1]
Wild Turkey	Whole watershed except open water, high intensity development	0.0344 animals/acre[2]
Ducks	Urban, residential, grassland, pasture, wetland, scrub/shrub, barren within 300 feet of streams and ponds	0.078 animals/acre[1]

[1]Source: *E. coli* TMDL Development for the Pamunkey River and Tributaries, VA Report (DEQ, 2014c)
[2]Wild Turkey habitat and densities were adjusted based on the recommendation of Virginia Department of Game and Inland Fisheries (DGIF, 2015).

Table 3-14: Estimated wildlife populations in the IP watersheds

IP Watershed	Deer	Raccoon	Muskrat	Beaver	Wild Turkey	Duck	Goose
Chapel Creek	799	899	3,882	424	799	249	475
Maracossic Creek	2,940	3,736	16,141	1,764	2,940	1,139	1,754
Matta River	1,398	1,872	8,084	883	1,398	580	838
Mattaponi River	2,395	3,475	15,016	1,638	2,395	1,292	1,457
Po River	1,971	2,610	11,280	1,228	1,971	815	1,186
Polecat Creek	1,050	1,443	6,230	679	306	447	627
Poni River	1,544	2,624	11,338	1,236	1,544	982	937
Reedy Creek	1,399	2,055	8,882	969	408	701	852

Table 3-15: Daily fecal coliform production and schedule for wildlife

Wildlife Species	Daily Fecal Coliform Production (cfu/day) *	Percentage of Day Spent in Stream*
Deer	2.93E+08	5%
Raccoons	9.45E+08	5%
Muskrat	1.90E+08	90%
Beaver	2.00E+05	100%
Goose	5.63E+07	50%
Wild Turkey	4.26E+05	5%
Ducks	5.25E+05	75%

* Source: *E. coli* TMDL Development of The Pamunkey River and Tributaries, VA (DEQ, 2014c)

3.4.6 Pets

Pet populations (dogs and cats) were estimated as part of the Mattaponi River TMDLs. Runoff carries pet waste from land to water during rainfall events. Average number of pets per household data were obtained from the American Veterinary Medical Association (AVMA, 2012) and used in conjunction with the number of households in the project area to estimate the total number of pets. While wastes from all pets can be a source of excess bacteria, the IP focuses on dogs since they are commonly walked by their owners, presenting an opportunity to pick up their waste. The formula for estimating dog populations in the project area is shown in Table 3-16, and the resulting estimated dog populations are provided in Table 3-17.

Table 3-16: The formula for estimating the number of dog-owning households

Animal	Factor
Dogs	Number of dog-owning households = 0.584 x total number of households

Table 3-17: Estimated dog populations in the IP watersheds

IP Watershed	Housing Units (2013 Estimate)	Number of Dogs
Chapel Creek	439	256
Maracossic Creek	1,741	1,018
Matta River	1,963	1,146
Mattaponi River	4,176	2,439
Po River	4,045	2,362
Polecat Creek	1,909	1,115
Poni River	4,685	2,736

IP Watershed	Housing Units (2013 Estimate)	Number of Dogs
Reedy Creek	2,236	1,306
Chapel Creek	439	256

3.4.7 Biosolids

In the development of the Mattaponi River bacteria TMDLs biosolids were not considered as a potential bacteria pollutant source (DEQ 2016a). The Virginia Pollution Abatement (VPA) regulation (9VAC25-32-30. A.) prohibits point source discharges of pollutants to surface waters, including wetlands, except in the case of a storm event greater than the 25-year, 24-hour storm. The VPA regulations were developed to ensure that neither infiltration nor runoff have an effect on aquifers. The regulation (9VAC25-32-560) requires the implementation of agricultural best management practices (BMPs) to reduce nonpoint source pollution from farmland. With regard to biosolids, this includes restrictions on application timing, application rate, slope, and, in particular, setback distances from sensitive environmental features designed to control and restrict the movement of biosolids after application.

Although biosolids were found not to contribute bacteria loads that needed to be addressed in the TMDL report, the topic of biosolids had a great deal of local stakeholder discussion during the IP meetings.

Two types of biosolids are used locally:

- Class B biosolids are delivered to agricultural producers in large volume (truckloads) and require a permit from DEQ to be applied. Permits specify storage and use requirements such as dry storage area, set-backs from streams, and timely field application following delivery.
- Class A biosolids are pelletized, sold commercially, and are not subject to permits. They do not have the type of storage and use requirements as Class B.

Both classes of biosolids are subjected to heat treatment/composting to remove bacteria. Class B biosolids may be applied to agricultural, silvicultural, and mined land reclamation sites (DEQ 2016b). Due to the DEQ permit requirements for biosolid applications, biosolids are not expected to impact surface water quality. Nonetheless, participants noted that many people believe biosolids could be a source of bacterial contamination to the Mattaponi River watersheds.

The Virginia Joint Legislative Audit and Review Commission (JLARC) published a report on Land Application of Biosolids and Industrial Residuals in 2017. JLARC found that the risk of land application of these materials is low under current regulation, and Virginia's regulatory compliance program is effective. The commission also recommended that VDH conduct a pilot epidemiological study of whether land application of biosolids could cause human health problems and test Virginia biosolids for certain viruses. DEQ began sampling biosolids for this study in March 2019, and VDH will send surveys to persons living adjacent to certain sites where biosolids are land applied in 2019. This study is not focused on the potential for biosolids to be a source of bacteria releases; rather, it is a study of the potential for airborne virus exposure from biosolids.

3.5 Water Quality Conditions

Since development of the 2016 Mattaponi River watershed bacteria TMDLs, additional monitoring data has been collected at several DEQ monitoring stations in the watershed. Updated analysis of all available water quality data was performed to inform IP recommendations on the most up-to-date water quality information.

Instream water quality monitoring data from December 2002 through December 2014 collected by DEQ at 15 monitoring stations were used in the development of the TMDLs. Since the development of the Mattaponi River TMDLs in 2016, additional water quality monitoring data became available at four of those stations, and three additional stations (not reflected in the 2016 TMDLs) have data that has identified additional impaired stream segments. Table 3-18 provides a summary of *E. coli* data from 18 DEQ monitoring stations where samples collected exceeded the maximum water quality assessment criterion of 235 cfu/100 ml for *E. coli*. Figure 3-11 shows the locations of these water quality monitoring stations.

Table 3-18: Summary of DEQ instream *E. coli* bacteria monitoring data for impaired stream stations during 2002-2018

Station ID	Impaired Stream	Period	No. of samples	*E. coli* Conc.		Maximum Assessment Criterion Exceedances	
				Average	Max	No. of Samples	Rate
8-BRK000.06	Brock Run	2004 - 2012	19	275	2000	7	37%
8-CPL004.15	Chapel Creek	2004 - 2016	35	191	960	16	46%
8-DOC000.69	Doctors Creek	2005 - 2011	18	221	1025	9	50%
8-GDY003.00	Glady Run	2007 - 2011	30	418	9208	8	27%
8-MAR003.24	Maracossic Creek	2002 - 2018	87	175	2000	31	36%
8-MAT001.87	Mat River	2010 - 2018	24	219	2282	11	46%
8-MOT002.62	Motto River	2005 - 2012	14	116	650	3	21%
8-MPN083.62	Mattaponi River	2004 - 2012	28	139	1400	6	21%
8-MTA001.69	Matta River	2003 - 2018	82	276	5172	37	45%
8-MTA008.96	Matta River	2009 - 2012	22	109	850	4	18%
8-PCT010.10	Polecat Creek	2009 - 2012	22	173	1200	5	23%
8-PNI002.43	Poni River	2007 - 2012	34	186	1600	10	29%
8-POR004.13	Po River	2007 - 2012	23	167	1600	4	17%
8-RDY003.43	Reedy Creek	2007 - 2012	23	183	2000	6	26%
8-ROT001.09	Root Creek	2011 - 2012	18	292	2000	7	39%
8-BEV003.16	Beverly Run	2005 - 2011	18	153	1250	2	11%
8-BEV006.78	Beverly Run	2014 - 2014	12	131	488	3	25%
8-BEV008.47	Beverly Run	2005 - 2011	17	84	300	1	6%

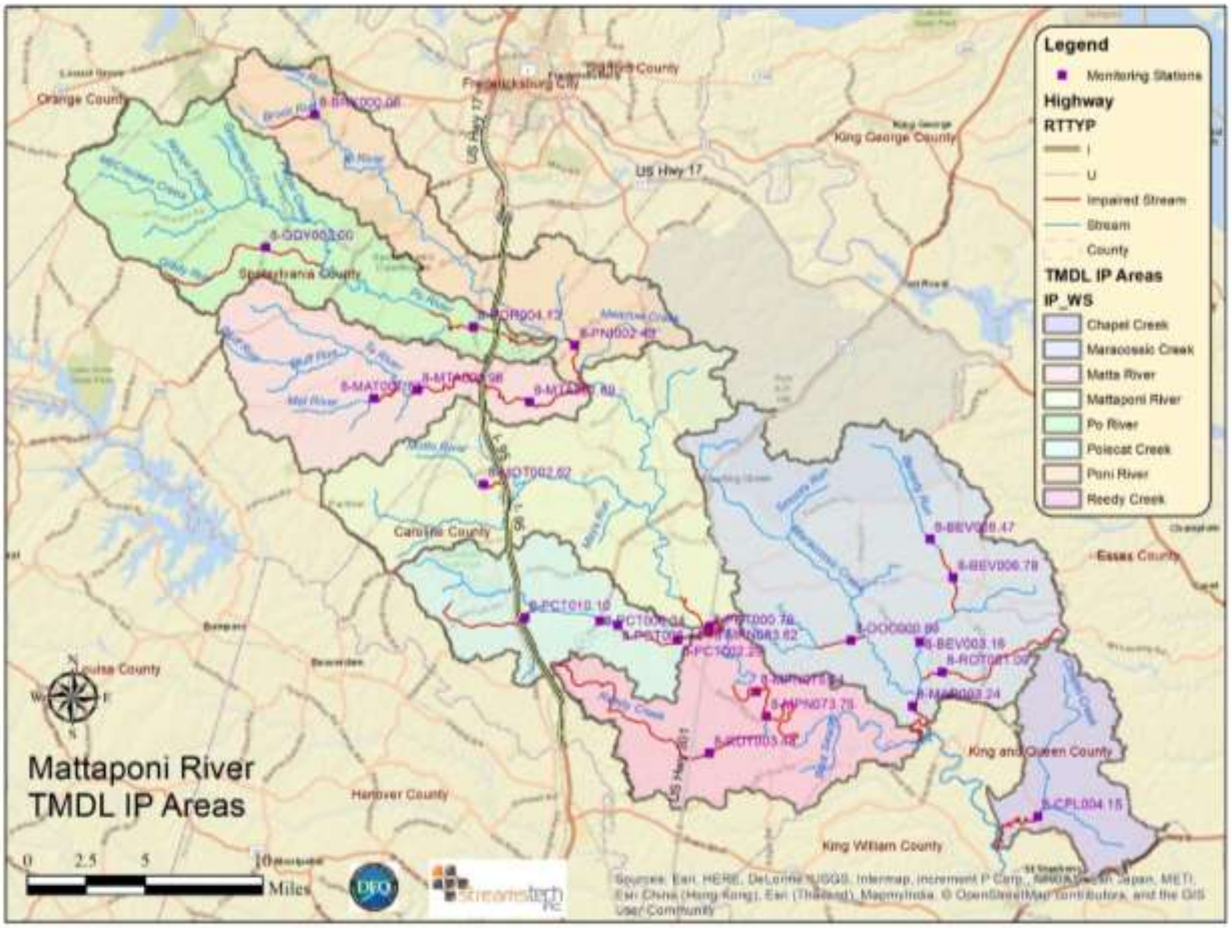


Figure 3-11: The DEQ monitoring stations used for bacteria impairment listings

EPA regulations, 40 CFR 130.7 (c)(1), require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. These requirements ensure that the water quality of the impaired streams is protected during times when it is most vulnerable and the numeric targets will be met under all other conditions. The updated water quality data from DEQ's monitoring stations and the stream flow data from USGS station 01674000, located on Mattaponi River near Bowling Green, were used to determine the critical conditions for each of the impaired segments.

An assessment of bacteria data was performed by segmenting the data by three flow regimes – high to mid-range flow, dry conditions and low flow to evaluate the importance of direct sources (e.g. direct deposition from cattle and straight pipes) and runoff-based nonpoint sources. The high to mid-range flow, dry conditions and low flow regimes are defined by a 'less than 60% probability of exceedance', a '60% to 90% probability of exceedance' and a 'greater than 90% probability of exceedance', respectively. A better understanding of the violation of the water quality standards at each monitoring station helped identify the actions necessary to effectively control the sources of pollution.

Under low flow conditions, due the absence of runoff water, any exceedances of the water quality criteria are presumed to be caused by direct sources of pollution. The streamflow is 'high to mid-range' during and after a storm or snowmelt and the runoff-based nonpoint sources of pollution generally have a larger impact on instream bacteria concentrations. Exceedances of water quality criteria during 'high to mid-range' flow are likely to be primarily associated with runoff-based nonpoint source pollution. Exceedances of water quality criteria during 'dry conditions' (the lowest 60-90% of flow rates for the stream, when smaller runoff amounts occur) may be associated with direct sources, runoff-based nonpoint sources or both. Table 3-19 provides a summary of *E. coli* data for each of monitoring stations under different flow regimes. Analysis of sampling results under the different hydrologic flow regimes is shown for the Matta River station (8-MTA001.69) in Figure 3-12.

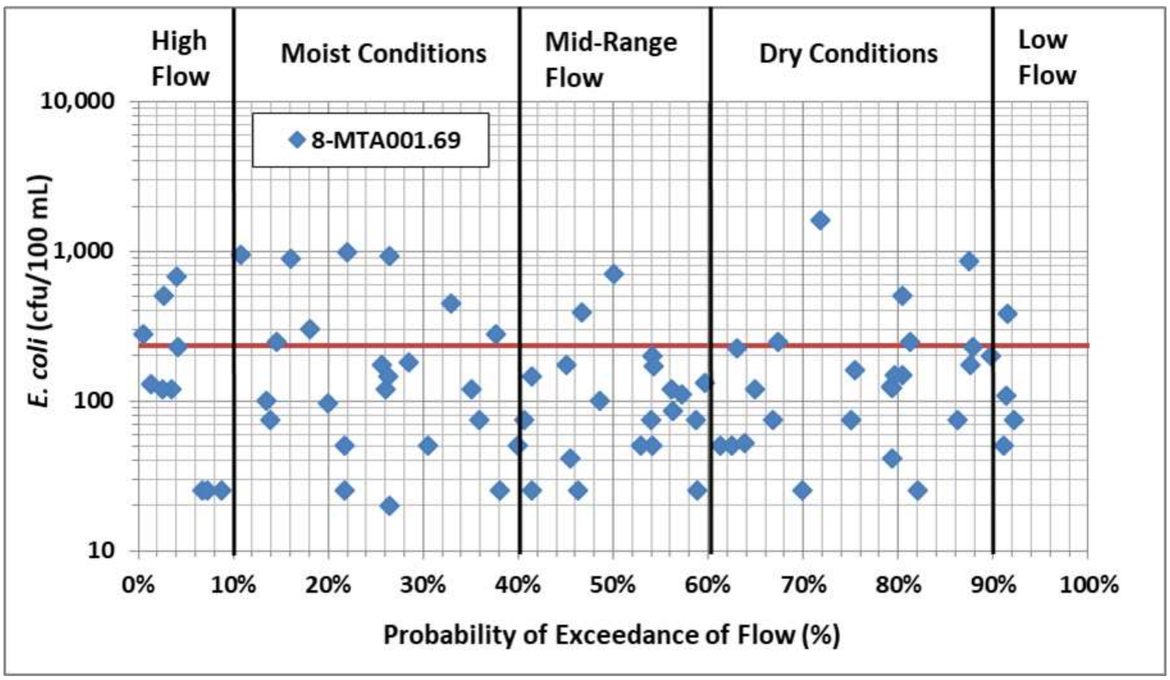


Figure 3-12: Sampling results under the different hydrologic flow regimes for the Matta Riverstation (8-MTA001.69)

The *E. coli* data from the Brock Run (BRK000.06), Doctors Creek (8-DOC000.69), Glady Run (8-GDY003.00), Motto River (8-MOT002.62), Mattaponi River (8-MPN083.62), Polecat Creek (8-PCT010.10), Reedy Creek (8-RDY003.43), and Root Swamp (8-ROT001.09) monitoring stations show that the water quality criterion were exceeded under high to mid-range flow and dry conditions. The water quality criterion was not exceeded at these stations under low flow. Therefore, available water quality monitoring data suggests that bacteria sources such as runoff-based nonpoint sources and failed septic systems are likely the major contributors to the Brock Run, Doctors Creek, Glady Run, Motto River, Mattaponi River, Polecat Creek, Reedy Creek, and Root Swamp impairments.

Table 3-19: Summary of *E. coli* data under different flow regimes for impaired stream stations during 2002-2018

Station ID	Impaired Stream	High to Mid-Range Flow (< 60% Exceedance Probability)		Dry Conditions (90-60% Exceedance Probability)		Low Flow (> 90% Exceedance Probability)	
		No. of Samples	Maximum Assessment Criterion Exceedances	No. of Samples	Maximum Assessment Criterion Exceedances	No. of Samples	Maximum Assessment Criterion Exceedances
8-BRK000.06	Brock Run	13	30.8%	5	40%	1	0%
8-CPL004.15	Chapel Creek	28	17.9%	7	29%	0	-
8-DOC000.69	Doctors Creek	9	33.3%	8	13%	1	0%
8-GDY003.00	Glady Run	23	21.7%	6	17%	1	0%
8-MAR003.24	Maracossic Creek	55	12.7%	26	38%	6	33%
8-MAT001.87	Mat River	17	17.6%	6	0%	1	100%
8-MOT002.62	Motto River	9	22.2%	4	25%	1	0%
8-MPN083.62	Mattaponi River	16	25.0%	10	10%	2	0%
8-MTA001.69	Matta River	54	25.9%	24	21%	4	25%
8-MTA008.96	Matta River	13	15.4%	6	0%	3	33%
8-PCT010.10	Polecat Creek	13	15.4%	6	17%	3	0%
8-PNI002.43	Poni River	20	10.0%	10	20%	4	25%
8-POR004.13	Po River	12	8.3%	9	11%	2	50%
8-RDY003.43	Reedy Creek	15	13.3%	7	14%	1	0%
8-ROT001.09	Root Swamp	10	30.0%	7	14%	1	0%
8-BEV003.16	Beverly Run	9	11.1%	8	0%	1	100%
8-BEV006.78	Beverly Run	9	11.1%	3	67%	0	-
8-BEV008.47	Beverly Run	8	0.0%	8	0%	1	100%

A review of the *E. coli* data form Maracossic Creek (8-MAR003.24), Mat River (8-MAT001.87), Matta River (8-MTA001.69 and 8-MTA008.96), Poni River (8-PNI002.43), Po River (8-POR004.13) and Beverly Run (8-BEV003.16, 8-BEV006.78 and 8-BEV008.47) stations show that exceedances occur under both low flow and high to mid-range flow regimes. The exceedances under low flow indicate that direct sources (e.g. straight pipe, direct deposition, failed septic systems, etc.) are possibly present in these watersheds. The exceedances under high to mid-range flow suggest that runoff-based nonpoint sources are also potential sources of pollution. Runoff-based nonpoint sources are the sources of bacteria that reach streams through stormwater runoff from the land, including pasture, cropland and developed lands. Since no sample was collected at Chapel Creek (8-CPL004.15) under low flow and exceedances occur under both high to mid-flow and dry conditions regimes, both runoff-associated and direct sources may contribute to the Chapel Creek impairment.

A comparison of existing loads from agricultural sources (see Figure 3-13 and Table 3-20) based on the TMDL allocations shows that the existing bacterial loads from pasture land account for 44 to 82 percent of the total loads in the impaired watersheds. Therefore, all the impaired watersheds require significant reductions from agricultural sources, particularly the nonpoint source loads from pasture land. Direct deposition loads from livestock to Brock Run, Glady Run, Mat River, Motto River, Po River, Polecat Creek and Reedy Creek range from 0.13 to 0.55 percent (see Table 3-20). Direct deposition load generally causes violations of water quality standards under low flow conditions. Therefore, even though the direct deposition load is much smaller than the runoff-based nonpoint sources, this poses a significant problem and requires the maximum reduction possible. In the impaired segments listed above, the contributions from direct deposition appear higher than the other impaired segments. Therefore, livestock exclusion/stream fencing best management practices (BMPs) and addressing any straight-pipe sewage discharges may be necessary in these watersheds. Table 3-21 provides a summary of bacterial load reductions from agricultural sources as required by the TMDL allocations.

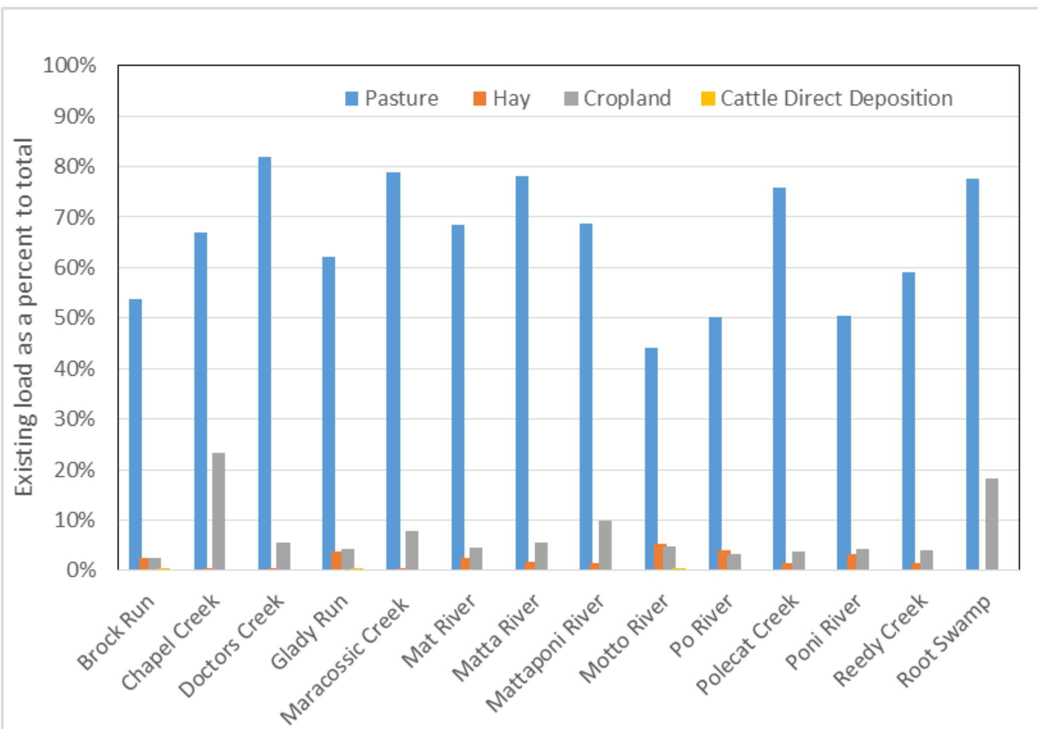


Figure 3-13: Distribution of bacterial loads from agricultural sources as a percent of total load under existing conditions (2012)

Based on the model results during the TMDL development, direct deposition loads to many impaired stream segments were shown to be less than 0.05 percent. However, in the Maracossic Creek, Matta River and Poni River watersheds, the analysis of water quality data discussed above suggests the TMDL analysis may have underestimated actual direct deposition loads. Based on the updated water quality analysis, looking for evidence of direct deposition from cattle and the presence of straight-pipe discharges seems warranted in the Maracossic Creek, Matta River and Poni River watersheds. Note that straight-pipe discharge of sewage wastes is illegal, and any identified occurrences must be addressed.

Table 3-20: Bacterial load from agricultural sources as a percent of total load under existing conditions (2012)

Impairment	Pasture	Hay	Cropland	Cattle Direct Deposition
Brock Run	53.8%	2.6%	2.5%	0.51%
Chapel Creek	66.9%	0.3%	23.4%	0.01%
Doctors Creek	81.9%	0.4%	5.6%	0.03%
Glady Run	62.1%	3.7%	4.3%	0.39%
Maracossic Creek	78.8%	0.4%	7.8%	0.01%
Mat River	68.4%	2.6%	4.5%	0.33%
Matta River	78.1%	1.7%	5.4%	0.03%
Mattaponi River	68.8%	1.4%	9.8%	0.01%
Motto River	44.0%	5.2%	4.9%	0.55%
Po River	50.2%	4.0%	3.3%	0.13%
Polecat Creek [1]	48.7%	0.9%	5.0%	0.05%
Poni River	50.4%	3.2%	4.3%	0.02%
Reedy Creek [1]	42.2%	0.7%	5.2%	0.06%
Root Swamp	77.5%	0.2%	18.2%	0.01%

[1] – The assessment and calculated bacteria loads were updated for the IP based on the expansion of the watershed boundaries (see page 10).

Table 3-21: Bacteria reductions required by the TMDL allocations

TMDL Watershed	Reductions from Pasture, Hay and Cropland Sources	Reductions from Cattle Direct Deposition and Failing Septic Systems
Brock Run	72%	100%
Chapel Creek	24%	100%
Doctors Creek	63%	100%
Glady Run	28%	100%

TMDL Watershed	Reductions from Pasture, Hay and Cropland Sources	Reductions from Cattle Direct Deposition and Failing Septic Systems
Maracossic Creek	18%	100%
Mat River	47%	100%
Matta River	46%	100%
Mattaponi River	28%	100%
Motto River	50%	100%
Po River	66%	100%
Polecat Creek [1]	27%	100%
Poni River	34%	100%
Reedy Creek [2]	18%	100%
Root Swamp	80%	100%

[1] – The necessary reductions from agricultural nonpoint sources to meet the water quality standards in the IP watershed is 25.8%. However, the TMDL allocations required 27% reduction, which was more conservative and, therefore, maintained.
[2] – The necessary reductions from agricultural nonpoint sources to meet the water quality standards in the IP watershed is 16.8%. However, the TMDL allocations required 18% reduction, which was more conservative and, therefore, maintained.

3.6 Modeling Update

The DEQ bacteria TMDL development process presents load allocation reductions that were modeled to meet the criteria in place at the time of development. The allocations developed were based upon results of no exceedances of the geometric mean criterion value and one or more load allocation scenarios that result in less than a 10.5 percent exceedance rate of the maximum assessment criterion. During development of the 2016 TMDL report, the maximum assessment criterion value of 235 cfu/100mL was used, in combination with the geometric mean value of 126 cfu/100mL, to determine bacteria reductions needed to achieve water quality standards for the recreational use.

Periodically, the Environmental Protection Agency reviews all of its recommended water quality criteria so that they reflect the best available science. The Virginia State Water Control Board recently adopted nationally recommended bacteria criteria published by the EPA. The new criterion that will be used in combination with the geometric mean value is referred to as the Statistical Threshold Value (STV), which has a value of 410 cfu/100mL. During development of this IP, the STV criterion was undergoing final public review and coordination with EPA before its formal adoption. The new bacteria criterion will influence all future impaired waters listing and delisting actions and TMDLs, however it was not applied to development of this IP. Accordingly, the BMP recommendations presented in this report are based on the maximum assessment criterion value of 235 cfu/100mL (and the geometric mean value of 126 cfu/100mL).

The DEQ (and EPA) expectation for TMDL implementation plans is to achieve bacteria reductions that will result in no exceedance of the geometric mean criteria and no more than 10.5 percent violation of the maximum assessment value. Since this IP is consistent with the water quality targets used in developing the Mattaponi River TMDLs (DEQ, 2016a) and no significant changes in pollution sources have occurred since the development of the TMDLs, the TMDL allocations and percent reductions in bacteria loads do not require any reassessment or adjustment.

However, the Polecat Creek and Reedy Creek IP watersheds each encompass areas that did not have TMDL allocations developed in 2016, and additional water quality modeling was required for these watersheds. Using procedures employed during development of the Mattaponi River TMDLs, existing bacteria loads and required reductions to achieve the water quality targets stated above have now been estimated for the Polecat Creek and Reedy Creek IP watersheds. The existing load and reduction estimates for Polecat Creek and Reedy Creek IP watersheds were prepared using the same bacteria criterion value used in the original 2016 TMDLs. Appendix C provides the details of updated Polecat Creek and Reedy Creek TMDLs.

Table 3-22 shows the load allocations (LA) by source, expressed as instream *E. coli* loads at the watershed outlet for the extended Polecat Creek IP watershed. Table 3-23 presents the same information for Reedy Creek IP watershed.

Table 3-22: *E. coli* bacteria loads and source load allocations for Polecat Creek IP watershed

Source	**Existing Load (cfu/yr)**	**IP Allocated Load (cfu/yr)**	**IP Reduction**
Forest and Wetland	1.47E+12	1.47E+12	0.0%
Urban	5.05E+13	3.75E+13	25.8%
Hay	1.07E+12	7.94E+11	25.8%
Pasture	5.59E+13	4.15E+13	25.8%
Cropland	5.72E+12	4.25E+12	25.8%
Cattle Direct Deposition	5.33E+10	0.00E+00	100.0%
Wildlife Direct Deposition	5.97E+09	5.97E+09	0.0%
Failing Septic Systems	7.76E+10	0.00E+00	100.0%
Total Load Allocation	**1.15E+14**	**8.55E+13**	**26%**

Table 3-23: *E. coli* bacteria loads and source load allocations for Reedy Creek IP watershed

Source	Existing Load (cfu/yr)	IP Allocated Load (cfu/yr)	IP Reduction
Forest and Wetland	2.76E+12	2.76E+12	0.0%
Urban	2.38E+13	1.98E+13	16.8%
Hay	8.37E+11	6.96E+11	16.8%
Pasture	4.85E+13	4.03E+13	16.8%
Cropland	5.97E+12	4.96E+12	16.8%
Cattle Direct Deposition	6.50E+10	0.00E+00	100.0%
Wildlife Direct Deposition	9.91E+09	9.91E+09	0.0%
Failing Septic Systems	3.01E+11	0.00E+00	100.0%
Total Load Allocation	**8.22E+13**	**6.85E+13**	**17%**

4 Public Participation

Collecting public input on conservation and outreach strategies to include in the IP is a critical step in the planning process. Local stakeholder support is a primary factor for success in carrying out the IP's recommended actions, since plans are implemented primarily by watershed stakeholders on a voluntary basis (often with financial incentives). A summary of the public and stakeholder meetings held as part of the development of this IP are identified in Table 4-1.

4.1 Initial Public Meeting

The initial public meetings served as an opportunity for local residents to learn more about the condition of local streams and the process used by the Commonwealth of Virginia to develop plans to restore water quality of impaired waterways.

Two public meetings were held to formally begin development of the implementation plan. The first of these was held on the evening of July 24, 2018 at the C. Melvin Memorial Library in Spotsylvania Courthouse. Given the large size of the IP watershed, a second opening public meeting was held on July 31 at the Town Hall in Bowling Green. These meetings were publicized through the *Virginia Register*, county websites, fliers and signs posted throughout the watershed, and direct email communications with participants of the TMDL development project. There were 8 participants in the July 24 meeting and 25 individuals at the July 31 meeting. Participants included local citizens and agricultural producers, state and local government agency representatives, soil and water conservation district staff, and representatives of Fort A.P. Hill and the National Park Service. Participants shared their input and ideas relative to a series of questions prepared by DEQ, following the opening presentation.

The discussions were in a single group for the smaller July 24 meeting in Spotsylvania Courthouse. During the larger July 31 meeting in Bowling Green, these discussions were conducted in two groups, one focused on agriculture and the other on residential areas. The opening presentation was the same for each meeting and provided relevant information on the IP area, current water quality, sources of bacteria pollution, the level of bacteria reductions needed to meet water quality standards, management practices commonly used to restore water quality impaired by excess bacteria, and the public participation process that DEQ uses to develop TMDL implementation plans. Appendix D-1 and D-2 provide a full summary of the discussions and comments during the two initial public meetings. A thirty-day public comment period followed these meetings, but no comment letters were received.

Figure 4-1: Participants in July 31, 2018 Public Meeting in Bowling Green

Table 4-1: Meetings held during the IP development process

Date	Meeting Type	Location	Attendance
07/24/18	Initial Public Meeting in Spotsylvania Courthouse	C. Melvin Snow Library	8
07/31/18	Initial Public Meeting, with Agricultural & Residential group discussions	Bowling Green Town Hall	25
11/07/18	Agricultural Working Group Meeting	Caroline County Public Library, Bowling Green Branch	14
01/09/19	Residential Working Group Meeting	Caroline County Public Library, Ladysmith Branch	17
03/27/19	Steering Committee	Bowling Green Town Hall	12
09/10/19	Final Public Meeting	Bowling Green Town Hall	22

4.2 Agricultural Workgroup Meeting

In the November 7, 2018 Agricultural Workgroup meeting, participants shared their knowledge of local agricultural activities, including existing conservation practices and more perspectives relevant to the IP. DEQ began the meeting with a summary presentation that included detailed information on local water quality and the type of agricultural conservation measures typically used to reduce bacteria in streams. There was considerable interest and discussion of the use of bio-solids in the watershed, with concerns expressed that they could be a source of bacteria. There was also discussion of the large wildlife populations in the area, and some participants expressed the view that wildlife may be a significant source of bacteria in IP area streams. Participants also shared their input relative to a series of questions prepared for the meeting by DEQ.

Workgroup discussions included expressions of interest in manure management for area horse/hobby farms, comments on the need for increased cost-share funding to promote multi-species cover crops, and the potential of increased interest in permanent conservation due to reduced availability of hay bailing equipment in area. As noted, there was discussion of concerns for large wildlife populations, and some participants believe that targeted reforestation might disperse wildlife populations. Use of bacteria source tracking analysis was advocated by some to more accurately identify the contribution of wildlife and other sources of bacteria in the plan area.

There was significant discussion of the use of bio-solids in the area, with good information exchanged about the different types of materials used, and what permit requirements and best practices are appropriate for their use. Meeting participants advocate that public information/education on bio-solids should be a part of the Mattaponi IP, as well as composting and manure management practices, so that the IP can help inform non-agricultural residents about the local agriculture sector. There was also discussion of kennels owned by landowners and hunting clubs in the area, and it was noted that cages are generally placed on concrete flooring and in "high and dry" areas. Participants expressed interest to learn more about what might be feasible to improve environmental management of kennels, and support inclusion of "confined canine unit" best management practices in the IP. A more complete summary of the Agricultural Workgroup meeting is found in Appendix D-3.

4.3 Residential Workgroup Meeting

In the January 9, 2019 Residential Workgroup meeting DEQ presented updated summary information and analysis of Mattaponi watershed water quality and discussed common septic system and developed land management practices used to address bacteria contamination. Two additional speakers presented information to inform workgroup discussions. Kevin Byrnes of Regional Decision Systems, LLC presented septic systems analysis he recently completed to inform the George Washington Regional Commission's Chesapeake Bay TMDL Watershed Implementation Plan, Phase III work with local jurisdictions. This analysis encompassed all properties within the plan area, identified those served by sewer and septic systems and documented the year septic systems were installed (or year of property development if septic date unavailable), and the type of soils. Dr. Charles Gowan, a professor of Biological Sciences at Randolph-Macon College, summarized student research in one of his applied environmental science classes. Students collected water quality samples from numerous locations in Ashland to identify bacteria hot-spots, and then conducted additional pin-pointed locational sampling/analysis to zero in on pet wastes and sanitary sewer system leaks that were found to be the sources of elevated bacteria levels in local streams.

Figure 4-2: Participants in January 9, 2019 Residential Workgroup Meeting in Ruther Glen, VA

Workgroup discussions included input on local practices to oversee septic system maintenance and ideas to improve maintenance, use of stormwater management practices and wetlands to limit runoff of bacteria contamination, and thoughts on areas where pet waste programs may be valuable. At the end of the meeting there was brief discussion of the use of bio-solids and whether they may be a potential source of bacteria contamination. Meeting participants support inclusion of residential septic, pet waste management, stormwater management and wetlands restoration practices in the Mattaponi IP. A complete summary of the Residential Workgroup meeting is found in Appendix D-4.

4.4 Steering Committee Meeting

A Steering committee that included seven representatives from the two workgroups and local counties as well as two members of the public who came to observe met on March 27, 2019 at the Town Hall in Bowling Green. The purpose of this meeting was to seek early feedback on preliminary IP report recommendations from a small group who had participated in earlier public and workgroup meetings. The meeting opened with an overview of the plan's development and a summary of initial BMP and other recommendations developed for inclusion in the IP report.

The opening presentation included information clarifying how the IP area has been modified from that presented in the initial public meetings to include additional areas adjacent to the original TMDL watersheds that have been identified as "impaired" for excess bacteria in the draft 2018 Virginia "Integrated Report." The segments now included in the IP area include sections of Polecat Creek and the Mattaponi River below the segments for which TMDLs were prepared in 2016. The Steering Committee indicated full support for this approach, which was explained in more detail in Chapter 3 above.

Most discussion focused on the preliminary recommendations for agricultural, residential septic, stormwater, and pet waste BMPs in the IP watersheds. Preliminary BMPs were summarized in a spreadsheet shared with members in advance of the meeting. A full summary of the meeting is found in Appendix D-5; some key points made during discussions were:

- Livestock Exclusion Fencing needs to satisfy requirements of the Chesapeake Bay Protection Act (CBPA), where applicable, so for many streams within the IP area, reduced fencing set-back distances (of less than 25 feet) would not be applicable. Participants supported DEQ's suggestion to indicate the IP watersheds with water quality analysis that indicates the likelihood of "direct deposit" bacteria should be priorities for fencing outreach/ implementation.
- Cropland management improvements using multi-species cover crops that include clover and legumes were recommended for their many benefits which include improved soil health and drainage, which reduces runoff.
- The Healthy Forest initiative, a program recently approved by the Virginia General Assembly, has the potential to incentive forest preservation and reforestation efforts in the future, and should be discussed in the IP report.
- Horse Farms will have BMPs added to the plan to support improved pasture and manure management. The DEQ specifications for demonstration manure management practices should be flexibly applied, to best meet area horse owners' needs.
- Residential Septic System BMPs were discussed and DEQ asked whether the IP should identify certain geographic areas, such as the CBPA management areas, as priorities for septic system maintenance. Participants suggested that all IP watersheds should be given attention, as those falling outside the CBPA coverage may not have as much understanding of system maintenance needs, since regular notifications are not provided to non-CBPA area septic owners.
- Pet Waste and Stormwater management BMPs were recommended to focus on the more heavily developed parts of the watershed, such as Bowling Green, Lake Caroline, Caroline Pines, Lake Land'Or, Ladysmith, and higher density areas in Spotsylvania County.

DEQ committed to share a full draft IP report with the Steering Committee for its informal review prior to completing the draft IP report for presentation at the final public meeting and formal public comment.

4.5 Final Public Meeting

Twenty-two people attended the final public meeting held on September 10, 2019 in Bowling Green. The primary purpose of this meeting was to present highlights of the draft IP, provide opportunities to answer questions from participants and initiate the 30-day public comment period. The public comment period extended from September 11 to October 11, 2019; DEQ did not receive additional public comments during that time.

The meeting began with DEQ presenting a short slide show summary of relevant background and the recommendations contained in the draft Mattaponi IP report and discussions occurred during and following the presentation. Initial questions and comments pertained to water quality information and DEQ explained that this IP addresses bacteria impairments, though there are some additional local impairments of the aquatic life and fish consumption uses associated with other pollutants. DEQ also observed that its water quality monitoring information is limited by available resources, and that more detailed reconnaissance during plan implementation will help to pin-point sources of contamination to be addressed.

There was significant discussion of residential septic system BMP recommendations, with questions to ensure recommendations were well understood. Participants offered comments that oversight of septic system maintenance required under the Chesapeake Bay Preservation Act has been insufficient, especially in recent years. DEQ explained that once approved, this IP can serve as a basis for Section 319 grants that will provide from 50 – 90 percent (varied based on residential income level) cost-share assistance for septic system BMPs. A participant observed that some residents in the IP area have such limited finances that even 90 percent cost-share assistance may not be sufficient to result in necessary action. DEQ and participants noted that there is a study underway that may support revisions to strengthen oversight of septic system maintenance in the future.

Participants were interested and supportive of recommendations to address stormwater runoff from developed lands, and some expressed concern that insufficient funding is available in Virginia to support such projects. Another commenter observed that the cost of stormwater management features required for new construction has served as a disincentive to economic development in some areas within the IP watershed. Participants also were interested to understand how DEQ had estimated bacteria from wildlife sources, and shared comments on wildlife present in the area. DEQ noted that while the recommended BMPs do not directly address wildlife bacteria, those that reduce runoff from areas that wildlife frequent should indirectly reduce wildlife bacteria reaching area streams. Participants offered contrasting views on whether these indirect reductions were likely.

At the end of the meeting, there was discussion of plans for a Fall 2019 Randolph-Macon College seminar class to conduct detailed water quality monitoring and analysis in the Po and Matta River IP watersheds, and DEQ noted that this analysis should be helpful to identify likely sources and opportunities to address bacteria releases. A Caroline County high school science teacher is also interested to include local water quality monitoring in her future lesson plans. A full summary of the meeting is found in Appendix D-6.

5 Implementation Actions

Implementation actions (aka BMPs or management measures) are the heart of the Mattaponi River IP. Individual actions will incrementally improve water quality and, in sufficient quantities and combinations, will enable the streams in the plan area to be removed from the impaired waters list.

In coordination with residents, government agencies, and other community groups, DEQ conducted an assessment of the IP area to identify and quantify bacteria reduction measures. The measures identified below are sufficient to restore the water quality of the impaired stream segments at the end of the 15-year implementation period (see Section 8 for a description of the implementation timeline). The proposed management measures are voluntary and designed to be flexible to react to changes in water quality over the course of the 15-year implementation period. This section describes the types of management measures recommended to improve the water quality of the impaired waters within the IP project area.

This IP does not address bacteria sources from wildlife directly, as it focuses on anthropogenic sources. However, the proposed management measures are expected to indirectly reduce bacteria pollution from wildlife, as a result of reducing bacteria loads in stormwater runoff. While no BMPs were proposed for forested lands, any treatment BMPs on other land uses (i.e. pasture and cropland) will reduce bacteria loads from wildlife equally.

Table 5-1 summarizes the necessary bacteria reductions to meet water quality standards that served as the basis of the 2016 TMDL. Table 5-2 lists the management measures recommended to achieve water quality goals, along with their bacteria reduction efficiencies and average cost per unit. Each category and the recommended management measures are discussed in more detail below.

Table 5-1: Reductions required to meet delisting goals by bacteria source

IP Watershed	Load Reductions (%)				
	Bacteria Sources				
	Cropland	Pasture	Developed Land (without failing septic systems)	Failing Septic Systems	Direct Deposition from Cattle
Chapel Creek	24%	24%	24%	100%	100%
Maracossic Creek	27%	28%	25%	100%	100%
Matta River	46%	46%	46%	100%	100%
Mattaponi River	29%	29%	29%	100%	100%
Po River	61%	57%	62%	100%	100%
Polecat Creek	27%	27%	27%	100%	100%
Poni River	36%	36%	36%	100%	100%
Reedy Creek	18%	18%	18%	100%	100%

Table 5-2: Summary of management measures, average unit cost, and bacteria reduction efficiency

Control Measure	Unit	Average Unit Cost ($)	Reduction Efficiency (%)
Livestock Exclusion			
CREP Livestock Exclusion (CREP, CRSL-6)	System	30,000	100%
Stream Exclusion with Grazing Land Management (SL-6)	System	25,000	100%
Livestock Exclusion with Reduced Setback (LE-2 / LE-2T)	System	17,000	100%
Stream Protection (WP-2 / WP-2T)	System	21,000	100%
Livestock Exclusion with Riparian Buffers (LE-1T)	System	36,000	100%
Pasture and Cropland			
Pasture Management for TMDL Implementation (SL-10T / EQIP 528)	Acre	120	50%
Permanent Vegetative Cover on Critical Areas (SL-11)	Acre	1200	75%
Sediment Retention, Erosion, or Water Control Structure (WP-1)	Acre	150	88%
Grass Riparian Buffers (WQ-1)	Acre	175	40%
Woodland Filter Buffer Area (FR-3)	Acre	450	40%
Conservation Tillage (SL-15A)	Acre	100	61%
Permanent Vegetative Cover on Cropland (SL-1)	Acre	175	75%
Sod Waterway (WP-3)	Acre	1,600	50%
Small Grain and Mixed Cover Crop (SL-8B)	Acre	48	20%
Equine			
Small Acreage Grazing System (SL-6AT)	System	9,000	100%
Small Scale Manure Composting for Equine Operations – Static Systems (EM-1T)	System	3,000	80%
On-Site Sewage Disposal Systems			
Alternative Waste Treatment System (RB-5)	System	24,000	100%
Connection to Public Sewer (RB-2)	System	11,000	100%
Septic System Pump-Out (RB-1)	System	300	5%
Repair Septic System (RB-3)	System	5,000	100%
Septic System Installation/Replacement (RB-4)	System	8,000	100%
Pet Waste Management			
Pet Waste Disposal Station (PW-1)	System	4,070	75%
Pet Waste Composter, Digester and Fermentation (PW-2)	System	225	50%
Stormwater Management			

Control Measure	Unit	Average Unit Cost ($)	Reduction Efficiency (%)
Rain Garden	/Treated Acre	5,000	80%
Constructed Wetland	/Treated Acre	2,900	80%
Wet Pond	/Treated Acre	8,350	70%
Riparian Buffer – Grass/Shrub	/Treated Acre	360	50%
Wetland Restoration	/Treated Acre	2,500	80%
Education and Outreach			
Septic System Education, homeowners and area realtors	/Year	350	N/A
Pet Waste Management Program	Program	5,000	60%
Organize Field Trips to Demonstrate Water Quality BMPs for Students	Program	1,000	N/A
Organize “Farm Day” Events to Demonstrate Agricultural BMPs	Program	1,500	N/A
Prepare Water Quality Educational Materials for Distribution at Farmer’s Markets/Local Environmental Forums	Program	3,000	N/A
Technical Assistance			
Agricultural and Residential	FTE($)/yr	60,000	N/A

5.1 Agricultural Implementation Needs

The largest amount of the bacteria reductions needed to meet water quality standards come from the agricultural sector (cropland, pasture, and direct deposition from cattle). Forty-nine to seventy-nine percent of the needed bacteria reductions come from pasture alone. Agricultural sources are presented in subsequent sections in the following groups: direct deposition of bacteria from cattle (livestock exclusion fencing), pasture and cropland, and equine. For each category, the methodology to quantify the effects of the proposed management measures is summarized along with the associated implementation actions.

5.1.1 Livestock Exclusion Fencing

Removing livestock from riparian corridors and limiting access to surface waterbodies is viewed as a priority management measure (Figure 5-1). As shown in Table 5-11 above, the 2016 TMDLs set forth a 100 percent reduction goal for bacteria of direct deposition from livestock. Although this amounts to a range from just 0.02 to 0.5 percent of total bacteria reductions needed, the bacteria load from direct deposition has highly adverse impacts on water quality during periods of low flow.

Figure 5-1: Livestock exclusion fencing in Fauquier County (June 2016)

As discussed in Section 3.4.4 above, there are estimated to be 124 miles of livestock exclusion fencing needed in the IP project area. According to the Virginia Department of Conservation and Recreation (DCR) database of agricultural practices (DCR 2016), the local Soil and Water Conservation Districts, particularly in the Chapel Creek, Matta River, Po River and Poni River IP watersheds, worked with landowners to install approximately 5 miles of livestock exclusion fencing since 2012. To achieve the reduction target, approximately 119 miles of additional livestock exclusion fencing is needed (Figure 5-2).

Table 5-3 provides a summary of the livestock exclusion opportunity analysis conducted and the amount of livestock exclusion fencing needed in each IP area. Figure 5-3 shows the location of livestock exclusion fencing opportunities in all IP watersheds.

Figure 5-2: Photograph of cattle with direct access to a stream

Table 5-3: Summary of livestock exclusion opportunity (miles) by IP watershed

Description	**Chapel Creek**	**Maracossic Creek**	**Matta River**	**Mattaponi River**	
CREP Livestock Exclusion (CREP, CRSL-6)	1.09	3.48	3.1	6.24	Cont'd
Stream Exclusion with Grazing Land Management (SL-6)	1.64	5.22	4.65	9.37	
Livestock Exclusion with Reduced Setback (LE-2 / LE-2T)	1.36	4.35	3.88	7.81	
Stream Protection (WP-2 / WP-2T)	1.09	3.48	3.1	6.24	
Livestock Exclusion with Riparian Buffers (LE-1T)	0.27	0.87	0.78	1.56	
Total LEF Fencing Needs	**5.45**	**17.4**	**15.51**	**31.22**	

Description	**Po River**	**Polecat Creek**	**Poni River**	**Reedy Creek**	**Total**
CREP Livestock Exclusion (CREP, CRSL-6)	4.64	1.3	2.3	2.63	**24.78**
Stream Exclusion with Grazing Land Management (SL-6)	6.97	1.96	3.44	3.94	**37.19**
Livestock Exclusion with Reduced Setback (LE-2 / LE-2T)	5.81	1.63	2.87	3.28	**30.99**
Stream Protection (WP-2 / WP-2T)	4.64	1.3	2.3	2.63	**24.78**
Livestock Exclusion with Riparian Buffers (LE-1T)	1.16	0.33	0.57	0.66	**6.2**
Total LEF Fencing Needs	**23.22**	**6.52**	**11.48**	**13.14**	**123.94**

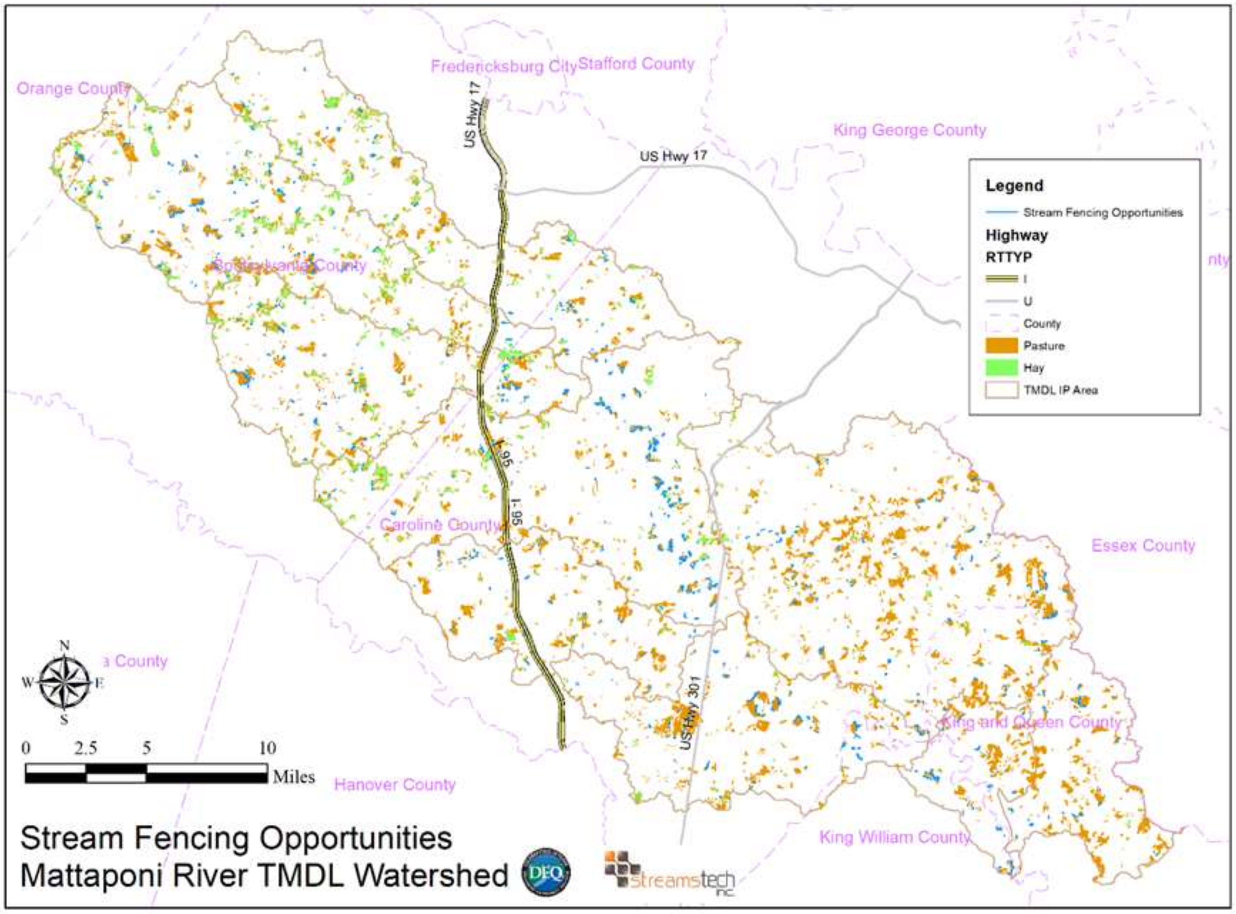


Figure 5-3: Location of livestock exclusion fencing opportunities

5.1.1.1 Methodology

The GIS analysis summarized in Section 3.4.4 provided a detailed objective starting point for identifying priority areas implementation of stream fencing during plan implementation. Potential fence locations were further adjusted by overlaying and editing the locations on Virginia Geographic Information Network (VGIN) satellite imagery data. Figure 5-3 shows the potential fencing location and land uses in a small area to illustrate the outcome of this method.

The local SWCDs have begun to look at large-scale aerial photo images of the plan area to identify locations currently used for livestock grazing. Together with local knowledge of the agricultural sector, the GIS analysis will help to uncover the best opportunities to reduce bacteria from livestock direct deposition to area streams.

To calculate bacteria reductions from proposed livestock exclusion fencing measures, the total bacteria load was divided by the total livestock exclusion opportunity to get an average bacteria load per linear foot of stream. Reductions were calculated using number of units of each proposed measure installed multiplied by the average bacteria load per linear foot of stream.

Figure 5-4: A large-scale map of the livestock exclusion opportunity analysis along tributaries to Mattaponi River using 2014 satellite imagery (VGIN 2014)

5.1.1.2 Implementation Actions

Multiple cost-share programs are available through DCR and USDA to help off-set the capital costs of installing livestock exclusion fencing in the IP project area. Management measures to achieve the necessary load reductions from direct deposition from cattle are presented in Table 5-4. A typical livestock exclusion practice has required a 35-foot riparian buffer, though recent program changes in Virginia could make 50-foot buffers more common.

Management measures LE-2 and LE-2T have allowed for a reduced setback (10 feet) and are recommended for limited use along tributaries or streams not within Chesapeake Bay Preservation Act (CBPA) resource protection areas (many perennial streams in the IP project area are subject to CBPA requirements). Within the CBPA, there is a requirement to maintain a riparian buffer of 100 feet around perennial streams. For agricultural lands that employ appropriate BMPs, the buffer distance around perennial streams may be less than 100 feet, but never less than 25 feet. With acknowledgement of the need to comply with CBPA requirements, the various livestock exclusion fencing (LEF) practices shown in Table 5-3 may be used interchangeably, based on the preference and eligibility considerations of area producers and the local SWCDs.

While not a requirement of livestock exclusion systems, improvements to riparian buffers are encouraged through planting of native plant species and tree planting (Figure 5-5). An improved riparian buffer will increase bacteria and nutrient removal efficiencies providing additional water quality and habitat benefits. Landowners can partner with local watershed organizations or schools to help improve the newly established riparian buffers.

Figure 5-5: Mature forested riparian vegetation in the IP area (David Nunnally, 2019)

Table 5-4: Recommended livestock exclusion management measures by IP Watershed, with Cost Estimates

Livestock Exclusion System	Avg. Unit Cost ($)	Avg. Streamside Fencing (ft)	Chapel Creek		Maracossic Creek		Matta River		Mattaponi River		
			Units	Cost ($)	Units	Cost ($)	Units	Cost ($)	Units	Cost ($)	
CREP Livestock Exclusion (CREP, CRSL-6)	30,000	2,900	1	30,000	5	150,000	6	180,000	7	210,000	**Continued**
Stream Exclusion with Grazing Land Mgmt. (SL-6)	25,000	3,680	2	50,000	4	100,000	5	125,000	6	150,000	
Livestock Exclusion with Reduced Setback (LE-2 / LE-2T)	17,000	3,400	2	34,000	5	85,000	4	68,000	9	153,000	
Stream Protection (WP-2 / WP-2T)	21,000	2,691	2	42,000	5	105,000	4	84,000	7	147,000	
Livestock Exclusion with Riparian Buffers (LE-1T)	36,000	3,400	1	36,000	2	72,000	1	36,000	2	72,000	
Total			**8**	**192,000**	**21**	**512,000**	**20**	**493,000**	**31**	**732,000**	

Livestock Exclusion System	Av. Unit Cost ($)	Avg. Streamside Fencing (ft)	Po River		Polecat Creek		Poni River		Reedy Creek		Total Units	Total Cost ($)
			Units	Cost ($)	Units	Cost ($)	Units	Cost ($)	Units	Cost ($)		
CREP Livestock Exclusion (CREP, CRSL-6)	30,000	2,900	6	180,000	2	60,000	5	150,000	4	120,000	36	1,080,000
Stream Exclusion with Grazing Land Mgmt. (SL-6)	25,000	3,680	4	100,000	3	75,000	5	125,000	3	75,000	32	800,000
Livestock Exclusion with Reduced Setback (LE-2 / LE-2T)	17,000	3,400	6	102,000	3	51,000	3	51,000	3	51,000	35	595,000
Stream Protection (WP-2 / WP-2T)	21,000	2,691	5	105,000	3	63,000	3	63,000	3	63,000	32	672,000
Livestock Exclusion with Riparian Buffers (LE-1T)	36,000	3,400	1	36,000	1	36,000	1	36,000	1	36,000	10	360,000
Total			**22**	**523,000**	**12**	**285,000**	**17**	**425,000**	**14**	**345,000**	**145**	**3,507,000**

5.1.2 Pasture and Cropland

The bacteria reductions in runoff from pasture and cropland required to achieve water quality goals range from a minimum of 54 percent in Polecat Creek IP watershed to a maximum of 93 percent in Maracossic Creek IP watershed. In the Poni River, Chapel Creek, Po River, Matta River, Mattaponi River, and Reedy Creek IP watersheds, the required bacteria load reductions from pasture and cropland account for 60 percent, 92 percent, 58 percent, 82 percent, 83 percent and 67 percent of the total reductions, respectively. There are two primary ways to reduce bacteria runoff from pasture or cropland: improved pasture or cropland management or land use conversion.

Since 2010, BMPs through state cost-share programs have benefited 111,805 acres across the IP area (DCR 2018a). As shown in Table 5-5 the majority of these practices are designed to reduce excess nutrient runoff, but because many practices reduce overall stormwater runoff, they also result in reductions in bacteria transported to area streams. Through these agricultural BMP installations, progress to reduce bacteria loads in the watershed has already occurred, however, significant work remains to achieve water quality goals for bacteria.

Cropland contributes a small percentage (four to ten percent in most IP watersheds) of overall bacteria to the Mattaponi IP area. Greater bacteria contributions from cropland are estimated in Maracossic Creek and Chapel Creek, 13 and 24 percent respectively. The management measures recommended to reduce bacteria runoff from fields also produce other valuable environmental and productivity benefits, including nutrient and sediment runoff reductions that are needed to achieve Chesapeake Bay cleanup goals. Frequent crop rotation and conversion from cropland to pasture to hay provides a challenge to implementing crop specific management measures in the IP area. In many cases, a single farm may have crops and pasture on the same land during different parts of the year. The 2011 NLCD identified 30,782 acres of cropland in the Mattaponi River Watersheds; however, that is likely to change from year to year.

5.1.2.1 Methodology

Pasture was identified using the land use data utilized in the development of Mattaponi River TMDLs (DEQ 2016a) and an average bacteria loading rate per acre was calculated by dividing the total bacteria load by the total area of pasture within each IP area. Using bacteria reduction efficiencies attributed to specific proposed management measures, total bacteria reductions were calculated to ensure reduction targets are met. It is important to note that individual bacteria reduction efficiencies may vary from farm to farm. Livestock exclusion fencing also provides a benefit to pasture and therefore was included in calculating total bacteria reductions. Reductions associated with livestock exclusion fencing were calculated prior to calculating reductions from additional pasture management measures as illustrated in Figure 5-6.

Table 5-5: A summary of best management practices installed between 2010 and 2018.

County	**Practice**	**Installed (2010-2018)**	
		Acres	**Lin. Feet**
Caroline	Continuous High Residue Minimal Soil Disturbance Tillage System	1,946.9	
	CREP Grass filter strips	1.1	
	Grass Filter Strip Rent	3.0	
	Harvestable Cover Crop	3,593.2	
	Late Winter Split Application of N on Small Grains	14.4	
	Long Term Continuous No-Till Planting System	954.6	

County	Practice	Installed (2010-2018)	
		Acres	**Lin. Feet**
	Long Term Vegetative Cover on Cropland	77.6	
	Nutrient Management Plan Implementation and Record Keeping	8,298.7	
	Nutrient Management Plan Writing and Revision	15,315.0	
	Nutrient Management Plan Writing and Revisions	553.0	
	Protective cover for specialty crops	229.2	
	Sidedress Application of Nitrogen on Corn	34.5	
	Small Grain and Mixed Cover Crop for Nutrient Management and Residue Management	14,058.3	
	Stream Exclusion With Grazing Land Management		11,788
	Subtotal	**45,079.6**	**11,788**
Essex	Split Application of Nitrogen on Corn using Pre-Sidedress Nitrate Test	16.4	
	Subtotal	**16.4**	
King & Queen	Continuous High Residue Minimal Soil Disturbance Tillage System	1,213.0	
	Fescue Conversion/Wildlife Option	11.0	
	Field Borders/Wildlife Option	61.7	
	Idle Land/Wildlife Option and Idle Tobacco Land	105.5	
	Late Winter Split Application of N on Small Grains	778.4	
	Long Term Continuous No-Till Planting System	85.1	
	Nutrient Management Plan Implementation and Record Keeping	110.9	
	Nutrient Management Plan Writing and Revision	6,673.5	
	Nutrient Management Plan Writing and Revisions	30,274.1	
	Precision Nutrient Management on Cropland	40.0	
	Small Grain and Mixed Cover Crop for Nutrient Management and Residue Management	2,937.5	
	Soil Test in Support of Nutrient Management Plan		
	Split Application of Nitrogen on Corn using Pre-Sidedress Nitrate Test	1,841.3	
	Stream Exclusion With Grazing Land Management		4,429
	Subtotal	**44,131.8**	**4,429**
King William	Continuous High Residue Minimal Soil Disturbance Tillage System	17.5	
	Fescue Conversion/Wildlife Option	5.9	
	Late Winter Split Application of N on Small Grains	120.8	
	Nutrient Management Plan Implementation and Record Keeping	29.1	
	Nutrient Management Plan Writing and Revision	718.0	
	Nutrient Management Plan Writing and Revisions	3,062.8	
	Small Grain and Mixed Cover Crop for Nutrient Management and Residue Management	1,033.9	
	Soil Test in Support of Nutrient Management Plan		
	Split Application of Nitrogen on Corn using Pre-Sidedress Nitrate Test	366.7	
	Subtotal	**5,354.8**	

County	Practice	Installed (2010-2018)	
		Acres	**Lin. Feet**
Orange	Animal waste control facilities		
	Harvestable Cover Crop	632.3	
	Long Term Vegetative Cover on Cropland	63.0	
	Septic Tank Pumpout		
	Small Grain and Mixed Cover Crop for Nutrient Management and Residue Management	242.1	
	Stream Exclusion With Grazing Land Management		2,000
	Subtotal	**937.4**	**2,000**
Spotsylvania	Animal waste control facilities		
	Continuous High Residue Minimal Soil Disturbance Tillage System	72.0	
	CREP Grazing land protection		7,705
	CREP Riparian Forest Buffer Planting	7.0	
	Harvestable Cover Crop	2,210.7	
	Livestock Exclusion with Reduced Setback		676
	Long Term Vegetative Cover on Cropland	88.6	
	Nutrient Management Plan Implementation and Record Keeping	1,143.8	
	Nutrient Management Plan Writing and Revision	2,643.3	
	Nutrient Management Plan Writing and Revisions	6,356.1	
	Riparian Buffer Rent	13.5	
	Small Grain and Mixed Cover Crop for Nutrient Management and Residue Management	3,750.1	
	Stream Exclusion - Maintenance Practice		960
	Stream Exclusion With Grazing Land Management		2,338
	Subtotal	**16,285.1**	**11,679**
Grand Total		**111,805.1**	**29,896**

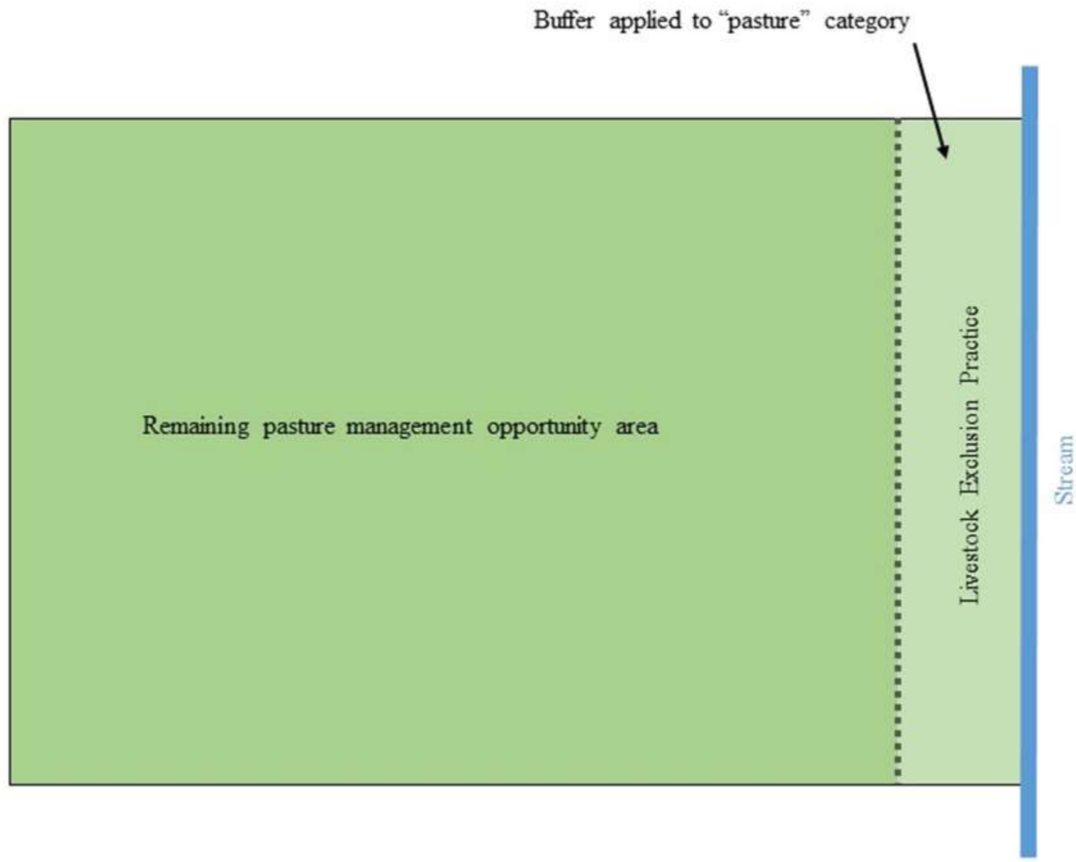


Figure 5-6: Bacteria reductions that are attributed to pasture, from the riparian buffer created with livestock exclusion fencing

The efficiency of management measures recommended in this IP to remove bacteria from runoff from pasture ranges from 50 to 88 percent. Most of the improved pasture measures have bacteria reduction efficiencies of 50 percent; therefore, the specific pasture improvement measure used on individual parcels can be adapted to meet parcel specific constraints and opportunities while achieving bacteria reduction goals. The recommended management measure that achieves an 88 percent reduction is considered a land use conversion practice (WP-1 converts erodible pastureland to a sediment retention water control structure).

5.1.2.2 Implementation Actions

Table 5-5 provides a list of management measures to reduce bacteria runoff from pasture and cropland. The combination of management measures (SL-1, SL-8B, SL-10T, SL-11, SL-15A and EQIP 528) may be mixed and matched depending on the individual circumstances of each landowner and the resources available. Working together, the local SWCDs and stakeholders can find the optimal, site-specific combination of practices for each farm. Because the bacteria efficiency for of these measures range from 20 percent to 75 percent, the distribution of these measures across the IP area should be selected following the recommendations in Table 5-5 to meet water quality goals.

Table 5-6: Management measures recommended for pasture and cropland

Pasture and Cropland Management System	Unit	Avg. Unit Cost ($)	Units	Cost ($)	Units	Cost ($)	Units	Cost ($)	Units	Cost ($)	Units	Cost ($)
			Chapel Creek		Maracossic Creek		Matta River		Mattaponi River			
Pasture Management System												
Pasture Management for TMDL Implementation (SL-10T / EQIP 528)	Acre	120	386	46,372	2,430	291,608	1,601	192,171	1,038	124,550		
Permanent Vegetative Cover on Critical Areas (SL-11)	Acre	1,200	52	61,829	174	208,291	92	109,812	104	124,550		
Sediment Retention, Erosion, or Water Control Structure (WP-1)	Acre	150	129	19,322	868	130,182	549	82,359	363	54,491		
Grass Riparian Buffers (WQ-1)	acre	175	10	1,750	42	7,350	47	8,225	76	13,300		
Woodland Filter Buffer Area (FR-3)	acre	450	7	3,150	32	14,400	28	12,600	30	13,500		
Subtotal			**584**	**132,422**	**3,546**	**651,831**	**2,317**	**405,167**	**1,611**	**330,392**		
Cropland Management System											Continued	
Conservation Tillage (SL-15A)	Acre	100	685	68,544	3,280	327,963	954	95,432	1,817	181,701		
Permanent Vegetative Cover on Cropland (SL-1)	Acre	175	480	83,966	2,400	419,953	568	99,409	606	105,992		
Sod Waterway (WP-3)	Acre	1,600	34	54,835	80	127,986	23	36,355	61	96,907		
Small Grain and Mixed Cover Crop (SL-8B)	Acre	48	171	8,225	400	19,198	114	5,453	303	14,536		
Subtotal			**1,371**	**215,571**	**6,159**	**895,099**	**1,659**	**236,650**	**2,786**	**399,137**		
Total			**1,955**	**347,993**	**9,705**	**1,546,930**	**3,976**	**641,817**	**4,397**	**729,528**		

Pasture and Cropland Management System	Unit	Avg. Unit Cost ($)	Units	Cost ($)	Units	Cost ($)	Units	Cost ($)	Units	Cost ($)	Units	Cost ($)
			Po River		Polecat Creek		Poni River		Reedy Creek		Total	
Pasture Management System												
Pasture Management for TMDL Implementation (SL-10T / EQIP 528)	Acre	120	3,434	412,116	511	61,296	985	118,185	88	10,560	10,474	1,256,858
Permanent Vegetative Cover on Critical Areas (SL-11)	Acre	1,200	137	164,846	51	61,296	79	94,548	18	21,600	706	846,773
Sediment Retention, Erosion, or Water Control Structure (WP-1)	Acre	150	1,030	154,544	128	19,155	394	59,093	-	-	3,461	519,144
Grass Riparian Buffers (WQ-1)	Acre	175	84	14,700	12	2,100	28	4,900	16	2,800	315	55,125
Woodland Filter Buffer Area (FR-3)	Acre	450	37	16,650	8	3,600	21	9,450	8	3,600	171	76,950
Subtotal			**4,723**	**762,856**	**710**	**147,447**	**1,507**	**286,176**	**130**	**38,560**	**15,126**	**2,754,850**
Cropland Management System												
Conservation Tillage (SL-15A)	Acre	100	1,634	163,427	609	60,910	649	64,911	130	12,958	9,758	975,847
Permanent Vegetative Cover on Cropland (SL-1)	Acre	175	802	140,399	292	51,164	303	53,011	130	12,094	5,580	965,988
Sod Waterway (WP-3)	Acre	1,600	30	47,542	24	38,982	22	34,619	130	13,822	403	451,049
Small Grain and Mixed Cover Crop (SL-8B)	Acre	48	149	7,131	122	5,847	108	5,193	130	2,073	1,496	67,657
Subtotal			**2,615**	**358,499**	**1,048**	**156,904**	**1,082**	**157,734**	**518**	**40,948**	**17,238**	**2,460,541**
Total			**7,338**	**1,121,355**	**1,757**	**304,351**	**2,588**	**443,909**	**648**	**79,508**	**32,364**	**5,215,391**

A spatial analysis identified approximately 4,975 acres of pasture land on slopes greater than ten percent. Lands meeting these criteria are located primarily in Spotsylvania and Caroline Counties. Figure 5-7, as an example, shows the pasture land in the Po River IP watershed with slopes greater than 10%. Permanent vegetative cover on critical areas (SL-11) should be prioritized on these areas to stabilize slopes thereby reducing erosion and sedimentation of adjacent streams.

The George Washington Regional Commission conducted a green infrastructure study for its four counties (Caroline, King George, Spotsylvania, and Stafford) and the City of Fredericksburg in 2011. Among other things, the study identified and mapped priority areas for creation of green space corridors to connect existing natural areas (conservation "cores") throughout the GWRC jurisdictions. Many of these corridors follow streams, and the woodland filter buffer practice (FR-3) could be used to create green space corridors, while improving the bacteria reduction efficiency of livestock exclusion practices. Relatedly, in recent years DGIF has acquired several large parcels in Caroline County that are among the existing conservation "cores" of the IP area. Connecting some of these areas via stream corridors may also be of interest in the future. Restoration and conservation projects within stream corridors between existing conservation core areas would support the goals of GWRC's Regional Green Infrastructure Plan, the bacteria reduction goals of this IP, and potentially other local conservation goals.

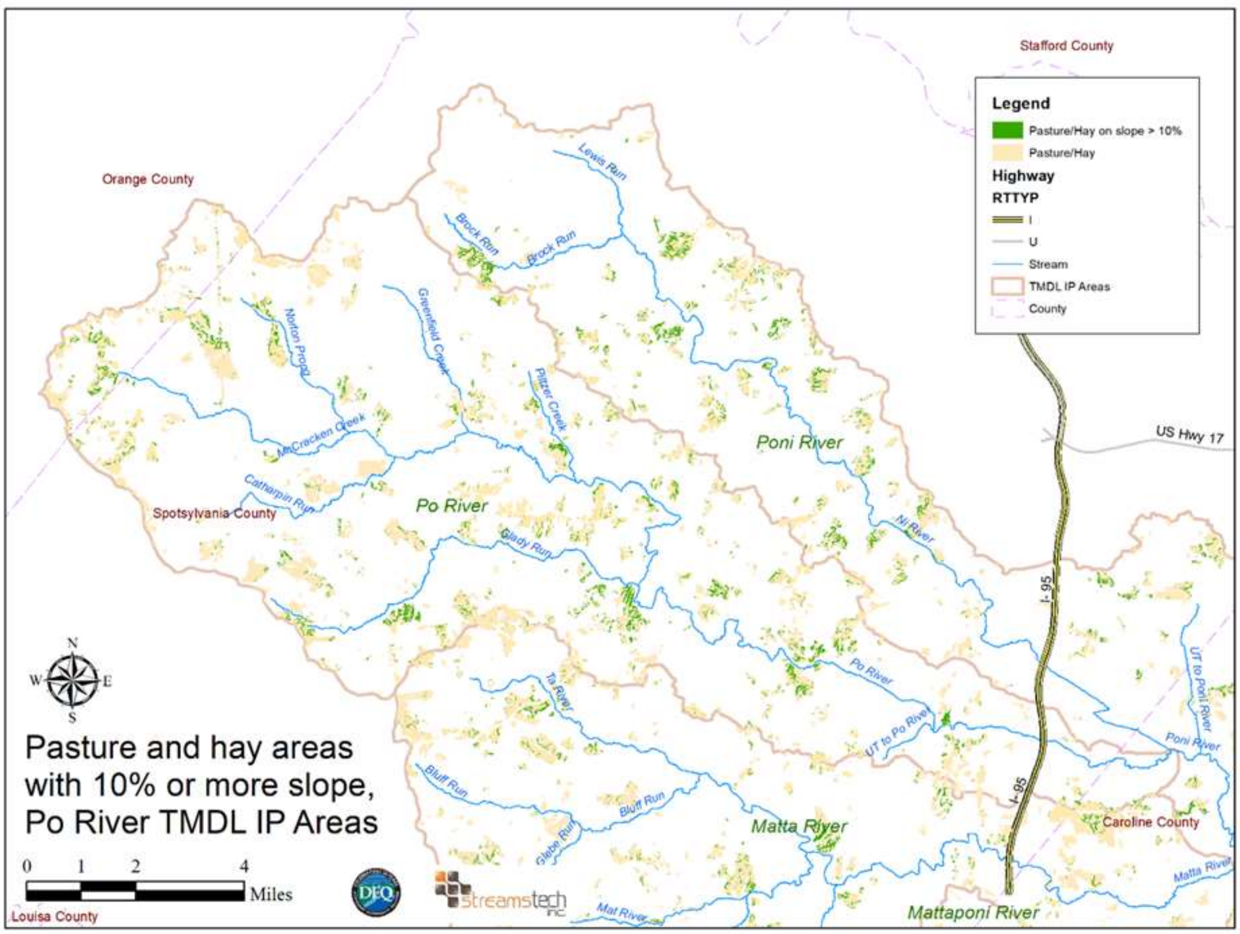


Figure 5-7: Location of pasture land on greater than ten percent slope in the Po River IP watershed

Agricultural stormwater management infrastructure (WP-1) can be applied to help manage runoff and prevent bacteria from entering local streams. Constructing stormwater infrastructure to manage runoff from pasture or fields has an estimated 88% bacteria removal efficiency, however this BMP results in significant loss of agricultural land production and can be cost prohibitive. Therefore, generally it should be considered if other management measures prove to be insufficient in the later phase of implementation.

Conservation tillage (SL-15A) and cover crops (SL-8B) are effective ways to address bacteria runoff from cropland, given the rotational nature of crop production. The integrity of riparian corridors should also be maintained (FR-3 and WQ-1). Mowing or plowing along swales is discouraged and, where possible, native vegetation should be allowed to return to improve of bacteria reduction effectiveness (Figure 5-8).

Figure 5-8: Grass buffer along a stream. Where possible, maintain the integrity of existing riparian buffers and reintroduce native vegetation along streams and swales

5.1.3 Equine Management

There are a significant number of horse farms in the Mattaponi IP project area, as was noted in Chapter 3 (also see Figure 3-11). During the Agricultural Workgroup and Steering Committee meetings participants recommended including equine management measures in this IP. The Hanover-Caroline SWCD (HC-SWCD) participant noted that in recent years, they have had 6-8 inquiries from Caroline County horse owners of opportunities for cost-share assistance to support improved conservation practices for their farms.

While the Virginia Agricultural Cost Share (VACS) program BMPs are not applicable to most horse farms, in 2018 DEQ added demonstration BMP practices to address equine manure sources that are eligible for Section 319 grant funding. Completion of this IP will increase opportunities to assist local horse farms with improving their operations to reduce bacteria, sediment and nutrient runoff to local streams. Proactively working with owners and boarding operations to properly manage horse manure will help ensure bacteria are kept out of area streams. Proposed equine management measures were separated from the other agriculture BMPs to assist in identifying opportunities for implementation and obtaining funding assistance.

5.1.3.1 Methodology

The number of horse farms in each IP area was estimated through communications with stakeholders and TAC members. It was assumed the average horse farm had five horses. To calculate overall bacteria reductions from equine, the average *E. coli* bacteria load was estimated using the fecal coliform bacteria production rate per horse provided in the 2016 TMDL Report.

5.1.3.2 Implementation Actions

Table 5-6 provides a list of management measures to address bacteria runoff specifically from horse farms that were identified at the AWG meeting and in discussions with local SWCDs. The Small Acreage Grazing System practice (SL-6AT) is designed to prevent manure and sediment runoff from heavy use areas and pastures from entering watercourses and to capture a portion of the manure as a resource for other uses such as fertilizer. This is accomplished by dividing the pasture into grazing paddocks. Livestock are rotated among paddocks as is necessary to maintain a permanent vegetative cover. One lot is stabilized and designated as a heavy-use area for use in periods of wet weather and when the grass in the grazing paddocks needs to rest and re-grow to the appropriate grazing height.

Composting manure, in combination with improved pasture management, can effectively address bacteria from equine operations. Composting facilities can vary in size and capital costs depending on the number of horses present at an individual farm. DEQ currently has two “Demonstration” BMPs (EM-1 and EM-2) available to address equine manure composting needs, with eligible cost-share amounts of $3,000 and $5,000, respectively at 75% cost-share). Small composting systems designed to handle manure from three to five horses may be less costly to construct micro-bins while constructing composting for more horses will require larger systems at greater expense. Figure 5-9 provides an example of a composting system for larger farms or boarding operations.

Figure 5-9: Horse manure composting structure (Washington State University Cooperative Extension 2016)

Barnyard runoff controls are structures which collect and divert runoff from barnyard or associated buildings into areas of low environmental impact. These structures are similar to stormwater management practices applied in a barnyard setting (Figure 5-10). The purpose is to store and filter nonpoint source pollution related to equine or other livestock. In some cases, it is possible to effectively collect, treat, and/or divert stormwater runoff concerns around barnyard areas with relatively inexpensive regrading of the surface to minimize erosion and runoff.

A common improvement may include appropriately sized gutters for barns and walk-in sheds that carry water from downspouts to outlets in a "safe" area away from any manure. High use area pads for feeding, watering and gateway areas, modified French drains for drip lines, infiltration trenches, and conservation landscaping (vegetated buffers) are also inexpensive and practical improvements. In other cases, simple grading and re-seeding (consistent with the SL-11 VACS practice to stabilize critical areas) may reduce bacteria runoff from horse farms.

Figure 5-10: Small acreage grazing system with heavy use area and diversion ditch in Great Run watershed, Fauquier County (photo by Claire Hilsen, John Marshall SWCD, 2015)

Table 5-7: Management measures to address bacteria runoff from equine.

Equine Measures	Avg.	Units	Cost ($)	Units	Cost ($)	Units	Cost ($)	Units	Cost ($)		
		Chapel Creek		Maracossic Creek		Matta River		Mattaponi River			
Small Acreage Grazing System (SL-6AT)	9,000	1	9,000	2	18,000	3	27,000	3	27,000	Continued	
Small Scale Manure Composting for Equine Operations – Static Systems (EM-1T)	3,000	1	3,000	1	3,000	3	9,000	3	9,000		
Total		**2**	**12,000**	**3**	**21,000**	**6**	**36,000**	**6**	**36,000**		
		Po River		Polecat Creek		Poni River		Reedy Creek		Total Units	Total Costs ($)
Small Acreage Grazing System (SL-6AT)	9,000	3	27,000	3	27,000	3	27,000	2	18,000	20	180,000
Small Scale Manure Composting for Equine Operations – Static Systems (EM-1T)	3,000	3	9,000	2	6,000	3	9,000	2	6,000	18	54,000
Total		**6**	**36,000**	**5**	**33,000**	**6**	**36,000**	**4**	**24,000**	**38**	**234,000**

5.2 Residential Implementation Needs

Non-agriculture sources of bacteria are considered residential in nature and include sources from septic systems, straight pipes, pets, and stormwater. Bacteria contributions from residential sources range from eight percent of the total bacteria load in the Chapel Creek IP watershed to forty-four percent of the total bacteria load in the Polecat Creek IP watershed. As specified in the 2016 TMDLs, reducing residential sources is required to achieve water quality standards.

Straight pipes is the term used for sewage discharged directly to a stream, without any form of treatment. Like direct deposition from cattle, straight pipes are a source targeted for 100 percent reduction in the TMDLs. During the Residential Workgroup meeting, DEQ inquired whether there were concerns for existing straight pipes in the IP project area. Participants indicated no knowledge of such instances; nevertheless, straight pipe discharges are illegal, and should be immediately addressed if they are identified in the future.

5.2.1 Septic Systems

As discussed in Chapter 3 and shown in Figure 5-11, the majority of the IP area is served by private septic systems due to the rural nature of the region. Specifically, a minimum of 65 percent of area homes in the Poni River IP area to a maximum 100 percent in the Chapel Creek IP area are served by individual septic systems, and there are no current plans to expand sewer service areas in the IP project area. In light of this, proper design and maintenance of these systems is required to prevent bacteria from entering surface water and groundwater resources.

Based on the 2018 analysis by Kevin F. Byrnes of Regional Decision Systems, L.L.C. of the septic and sewer system data from VDH and local governments, there are an estimated 16,595 septic systems in the IP area. The septic systems with an age between 0 to 20 years ranged from a minimum of 23 percent of septic systems in the Maracossic Creek IP area to a maximum of 40 percent in the Matta River IP area. Therefore, a large percentage of septic systems in the IP watersheds are older than 20 years. The septic systems in the Chesapeake Bay Preservation area are required to be pumped or inspected at least once in every five years. Limited locally available data suggests that 70 percent of the systems were pumped-out, filter replaced and/or inspected in the five-year period prior to 2011. Therefore, while septic system pumpout activity is significant, it needs to be increased further to reduce bacteria releases from residential septic systems.

5.2.1.1 Methodology

As explained in Chapter 3, Kevin F. Byrnes of Regional Decision Systems, L.L.C. recently collected and analyzed septic and sewer system data from VDH and local governments to estimate the George Washington Regional Commission's BMP projections for local jurisdictions as input to the Chesapeake Bay TMDL Watershed Implementation Plan (WIP), Phase III. He subsequently provided the GIS data of the septic systems and homes with sewer connections in the Mattaponi IP watersheds to enable more precise septic system BMP recommendations. Mr. Byrnes extracted from VGIN's address point file released October 1, 2018 and identified septic/sewer data based on public records provided by Spotsylvania and Caroline counties. For any unidentified address the waste disposal system was treated as "unknown." Alternative Onsite Sewage Systems (AOSS Septic) were identified using the filed Operation and Maintenance reports to VDH VENIS system. All Orange, Essex, King & Queen and King William County systems were assumed to be on conventional septic systems. Due to lack of service area data, all the addresses in Bowling Green were assumed to be connected to the town's sewer system. The data prepared by Byrnes was the foundation for a precise analysis of the septic systems in the IP watersheds and estimating the management measures required to eliminate the discharge from failed septic systems.

5.2.1.2 Implementation Actions

Table 5-7 describes management measures to help support existing county programs. These measures were identified in consultation with local stakeholders. Local Counties inform their residents who are subject to CBPA pumpout requirements of their obligation, and they request notification by homeowners of septic maintenance work completed. Existing county resources to not support active follow-up with residents who do not comply with CBPA requirements, and residents in areas not subject to CBPA requirements have no specific septic information and outreach from local counties.

Proper septic system maintenance will help to prevent bacteria from reaching local waterways. Distributing proper maintenance guidelines and pump-out reminders can more effectively inform homeowners of their obligations and prevent septic system failure. A model of excellent communication and follow up of septic system best maintenance practices exists in the Lake Caroline Community, and is supported by the Citizen Association's annual fees. With nearly 2,000 existing homes, all on individual septic systems, Lake Caroline water quality monitoring documents just one exceedances of the Virginia water quality criterion for *E. coli* bacteria in 84 samples collected in 2017 at multiple near shore locations. Septic system cost-sharing and an active septic system education and outreach program for the entire IP project area can help improve water quality and extend the life of resident's existing septic systems.

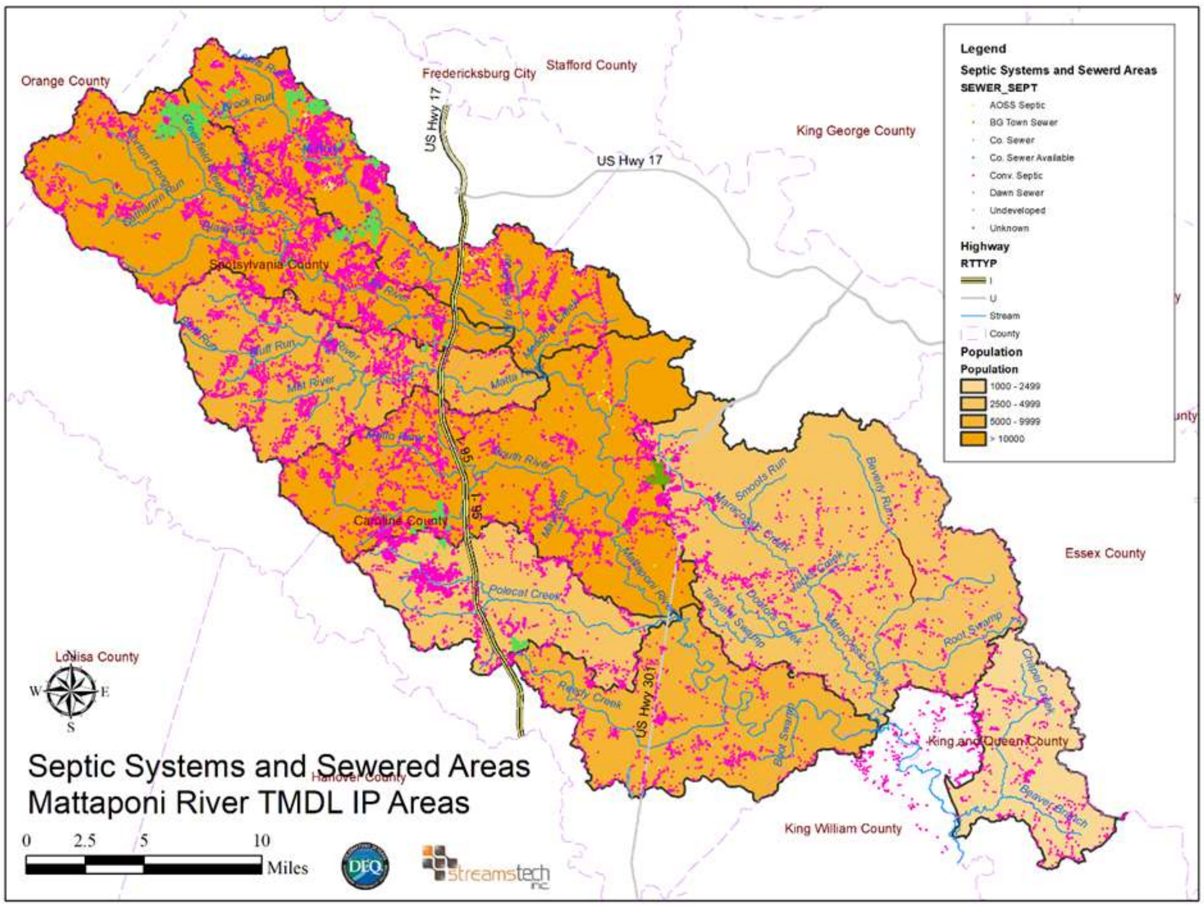


Figure 5-11: Septic systems and sewered areas in the Mattaponi River IP watersheds

Households located in existing municipal wastewater treatment service area that remain on individual septic systems should be encouraged to connect to the public sewer system. Over the course of the 15-

year implementation planning timeline, there may be opportunities to connect residents with failing septic systems to existing sewer treatment systems, and management measure RB-2 (connection to a public sewer) can help offset the capital cost of a sewer connection. This IP does not identify specific parcels for sewer connection but estimates the potential for 47 new connections based on the number of existing connections and total parcels within the sewer service areas. Additional low income assistance should be made available through other grant or micro-loan programs when possible. In 2018, DEQ modified its Residential Septic System BMP guidelines to allow for up to 80-90 percent cost-share assistance for septic system BMPs for residents earning less than 50 percent of the local (county) median income. This assistance is provided as part of Section 319 grants.

Table 5-8: Management measures to address bacteria loads from septic systems

On-Site Sewage Disposal System Measures	Avg. Unit Cost ($)	Units	Cost ($)	Units	Cost ($)	Units	Cost ($)	Units	Cost ($)	Units	Cost ($)
		Chapel Creek		Maracossic Creek		Matta River		Mattaponi River			
Alternative Waste Treatment System (RB-5)	24,000	1	24,000	2	48,000	2	48,000	3	72,000		
Connection to Public Sewer (RB-2)	11,000	-	-	5	55,000	6	66,000	10	110,000		
Septic System Pump-Out (RB-1)	300	388	116,400	1,429	428,700	1,685	505,500	2,797	839,100	Continued	
Repair Septic System (RB-3)	5,000	48	240,000	234	1,170,000	373	1,865,000	384	1,920,000		
Septic System Installation/Replacement (RB-4)	8,000	3	24,000	3	24,000	6	48,000	10	80,000		
Total		**440**	**404,400**	**1,673**	**1,725,700**	**2,072**	**2,532,500**	**3,204**	**3,021,100**		
		Po River		Polecat Creek		Poni River		Reedy Creek		Total	
Alternative Waste Treatment System (RB-5)	24,000	3	72,000	9	216,000	3	72,000	2	48,000	25	600,000
Connection to Public Sewer (RB-2)	11,000	10	110,000	5	55,000	10	110,000	1	11,000	47	517,000
Septic System Pump-Out (RB-1)	300	2,871	861,300	1,523	456,900	3,185	955,500	733	219,900	14,611	4,383,300
Repair Septic System (RB-3)	5,000	432	2,160,000	172	860,000	382	1,910,000	59	295,000	2,084	10,420,000
Septic System Installation/Replacement (RB-4)	8,000	10	80,000	9	72,000	10	80,000	4	32,000	55	440,000
Total	**24,000**	**3,326**	**3,283,300**	**1,718**	**1,659,900**	**3,590**	**3,127,500**	**799**	**605,900**	**16,822**	**16,360,300**

5.2.2 Pet Waste

Pet waste is another source of bacteria entering local waterways from residential sources. Many pet owners do not always make the connection between pet waste and local water quality (Figure 5-12). During rain events, bacteria from pet waste can run off lawns into local streams. Proper disposal of pet waste will eliminate associated bacteria from reaching local waterways and keep public parks and gathering places clean.

Figure 5-12: Pet waste can contribute to poor water quality if it is not picked up and properly disposed

5.2.2.1 Methodology

While wastes from all pets can be a source of excess bacteria, the IP focuses on dogs since they are commonly walked by their owners, presenting an opportunity to pick up their waste. The number of dogs living in the IP area was calculated using number of households multiplied by the average number of dogs per household according to the AVMA's 2012 survey (AVMA 2012).

5.2.2.2 Implementation Actions

Table 5-8 lists the management measures to address pet waste in the IP area. During the Residential Workgroup meeting, participants agreed that the IP should include recommended BMPs and an education and outreach program to address pet waste sources of bacteria. While no specific areas were identified as top priorities, participants suggested that education and outreach should focus on the more heavily developed areas within the IP watersheds. To allow for education and outreach to be eligible for future Section 319 grant funding throughout the IP project area, each watershed within the IP area includes a pet waste education and outreach program. In practice these outreach programs may cover more than a single IP watershed, which is to say not all IP watersheds will require a unique program. To allow for the specific pet waste BMPs to be eligible for funding in all IP watersheds where there may be interest to pursue them, all watersheds include some level of pet waste BMPs, with the number varied based on the population of the watershed. Where they exist, neighborhood homeowner associations are encouraged to install pet waste stations and pet waste composters.

Table 5-9: Management measures to address bacteria runoff from pet waste

Pet Waste Measures	Avg. Unit Cost ($)	Units	Cost ($)	Units	Cost ($)	Units	Cost ($)	Units	Cost ($)	Units	Cost ($)
		Chapel Creek		Maracossic Creek		Matta River		Mattaponi River			
Pet Waste Disposal Station (PW-1)	4,070	3	12,210	28	113,960	18	73,260	34	138,380	Continued	
Pet Waste Composter, Digester and Fermentation (PW-2)	225	4	900	59	13,275	60	13,500	75	16,875		
Total		**7**	**13,110**	**87**	**127,235**	**78**	**86,760**	**109**	**155,255**		
		Po River		Polecat Creek		Poni River		Reedy Creek		Total	
Pet Waste Disposal Station (PW-1)	4,070	37	150,590	12	48,840	19	77,330	2	8,140	153	622,710
Pet Waste Composter, Digester and Fermentation (PW-2)	225	187	42,075	27	6,075	64	14,400	6	1,350	481	108,225
Total		**224**	**192,665**	**39**	**54,915**	**83**	**91,730**	**8**	**9,490**	**634**	**730,935**

5.2.3 Stormwater

Stormwater BMPs can help achieve numerous water quality objectives by filtering and retaining pollutants during and after storm events. These management measures can be installed in both urban and residential settings. Overall, stormwater runoff from developed land accounts for a total bacteria load ranging from 8 percent in the Chapel Creek IP area to 44 percent in the Polecat Creek IP area and the majority of this bacteria is linked to pet waste, which is addressed in Section 5.2.2. Measures to address the remaining urban and residential stormwater loads are described in this section. As bacteria in developed land stormwater is a relatively small contributor to the impairments, the measures described are recommended primarily as pilot projects to serve as community demonstrations of best practices.

Figure 5-13: Bioswale to catch runoff from parking lot, Marshall, Virginia (September 2016).

Figure 5-14: Stormwater retention pond behind commercial development, Marshall, Virginia (September 2016)

5.2.3.1 Methodology

Bacteria loads from developed lands (not including failing septic systems) from the 2016 TMDLs were divided by the total acres of developed land to estimate a bacteria loading rate per acre. Proposed management measures were multiplied by treatment area and reduction efficiency to estimate total bacteria reductions.

5.2.3.2 Implementation Actions

The proposed management measures in Table 5-9 are intended both as opportunities to address stormwater runoff/local flooding issues of concern, and to educate residents of the benefits of stormwater BMPs. A few highly visible BMPs can increase awareness of the benefits of these systems to address water quality, flooding, and streetscape concerns across the IP area (Figure 5-13 and Figure 5-14). County government facilities such as schools and parks may provide ideal locations for installation of demonstration stormwater BMPs especially when capital improvements are planned. For example, rain gardens, wet ponds, and riparian buffers can both reduce stormwater runoff transported downstream from developed areas, slow the velocity of stormwater runoff (which reduces erosion and pollutant mobilization), and reduce the transport of bacteria and other pollutants downstream.

In several of the IP meetings, participants expressed interest for this plan to recommend wetlands creation/ restoration where it could support bacteria reduction goals and offer additional ecological benefits. As with other watersheds located within the Coastal Plain ecosystem, a high proportion of the low-lying lands in the Mattaponi River watershed historically were wetlands. Wetlands are defined by having a wet hydrologic regime, wetlands tolerant plant life, and the presence of hydric soils. Many wetlands in the IP area were drained generations ago to support agricultural and developed land uses, but they retain their hydric soils properties. If wetlands hydrology is restored by removing ditching and other hydrologic modifications used to dry out the land, highly productive wetlands with many ecological benefits can be restored.

Consistent with the participants' interests, the IP recommends a modest amount of wetlands creation or restoration BMPs in all IP watersheds to allow interested landowners to seek funding support for wetlands they may wish to restore/create. The USDA has several conservation programs that include eligibility for wetlands restoration, and with an approved IP Section 319 funds would also be sources of funding support for this work. Wetlands have bacteria reduction efficiencies of 80 percent so they are even more effective than riparian buffers to reduce bacteria that reaching streams from stormwater runoff.

Table 5-10: Management measures to address bacteria pollution from stormwater

Stormwater Measures	Avg. Unit Cost ($)	Units (ac)	Cost ($)	Units (ac)	Cost ($)	Units (ac)	Cost ($)	Units (ac)	Cost ($)	Units (ac)	Cost ($)
		Chapel Creek		Maracossic Creek		Matta River		Mattaponi River			
Rain Garden	5,000	1	5,000	2	10,000	2	10,000	2	10,000		
Constructed Wetland	2,900	5	14,500	33	95,700	59	171,100	45	130,500		
Wet Pond	8,350	1	8,350	2	16,700	3	25,050	15	125,250	Continued	
Riparian Buffer – Grass/Shrub	360	131	47,160	444	159,840	237	85,320	594	213,840		
Wetland Restoration	2,500	5	12,500	33	82,500	59	147,500	45	112,500		
Total		**143**	**87,510**	**514**	**364,740**	**360**	**438,970**	**701**	**592,090**		
		Po River		Polecat Creek		Poni River		Reedy Creek		Total	
Rain Garden	5,000	4	20,000	3	15,000	26	130,000	1	5,000	41	205,000
Constructed Wetland	2,900	147	426,300	94	272,600	153	443,700	20	58,000	556	1,612,400
Wet Pond	8,350	25	208,750	78	651,300	13	108,550	17	141,950	154	1,285,900
Riparian Buffer – Grass/Shrub	360	490	176,400	312	112,320	766	275,760	70	25,200	3,044	1,095,840
Wetland Restoration	2,500	147	367,500	94	235,000	153	382,500	20	50,000	556	1,390,000
Total		**813**	**1,198,950**	**581**	**1,286,220**	**1,111**	**1,340,510**	**128**	**280,150**	**4,351**	**5,589,140**

5.3 Education and Outreach

Education and outreach programs are important to the successful implementation of proposed management measures. Informing residents of the importance of protecting local water quality and increasing awareness of the programs available to help with capital costs to install management measures will assist in successful implementation and meeting bacteria reductions targets over the 15-year planning horizon. Education and outreach also provides an opportunity for residents and stakeholders to provide feedback with regard to what programs are working and whether plan adjustments are needed to meet reduction goals.

5.3.1 Implementation Actions

Local SWCDs are typically the most important leaders in local watershed restoration efforts in Virginia, and are the most common applicants for/recipients of Section 319 grants targeted to support implementation projects for EPA-approved IPs. In addition to the three local SWCDs, counties, cities and towns, regional commissions, and non-governmental organizations are all eligible to apply for Section 319 grants to carry out the recommended BMPs included in approved implementation plans. Given the large size of the IP project area (more than 400,000 acres covering significant portions of five counties), both the recommended education and outreach, and technical assistance activities were estimated assuming that up to three Section 319 grants could be active throughout plan implementation.

Table 5-10 provides a list and brief description of the proposed education and outreach programs recommended to support implementation of this plan. Information can be distributed through a variety of communication mediums including social media, print media, newsletters, and radio advertisements. Local homeowner and civic associations, environmental and conservation organizations, county and town agencies, local veterinarians, and engaged individuals can all spread the message about cost-share programs and benefits of improved agricultural, residential septic, and developed land management practices.

5.3.1.1 Septic System Owner Education and Outreach to Area Realtors

Under this program, information about proper septic system maintenance and obligations of septic system owners under the municipal code can be disseminated as mailers in utility bills, refrigerator magnets, or similar materials. Specific outreach to area realtors can help inform prospective homeowners of their obligations and proper maintenance of septic systems when purchasing a home with a septic system should be included. Information about cost-share programs to help offset capital costs should also be distributed particularly to lower income households, and county social service offices may be able to help focus outreach to low-income area residents.

5.3.1.2 Pet Waste Management Education Programs

A robust education and outreach campaign is recommended to inform pet owners of the importance of picking up after their pet. Distributing dog waste bag leash holders is an inexpensive and popular program to spread the message. Opportunities to distribute educational materials include a variety of local community events, farmers markets, and in public display areas in more heavily developed areas. Local homeowner and civic associations should be engaged to encourage them to share pet waste management information with their members.

5.3.1.3 Incorporate Water-Related Curriculum into Area Classrooms/Student Field Trips

The Virginia Department of Education (DOE) requires watershed-related curriculum as part of 3rd through 6th grade science education (DOE 2016). As part of addressing water quality concerns in the IP area, local watershed organizations and SWCDs can continue to ensure students are receiving a "meaningful watershed experience" (CBF 2004). Expansion of existing programs and promotion of locale-specific efforts promotes a "sense of place" in children, engages parents in local water quality problems, and brings communities together to find solutions. The local SWCDs have organized student field trips to areas in the IP area where management measures have been installed to support the lessons taught in the classroom, and Section 319 grant funding could be used to enhance these existing efforts.

Table 5-11: Education and outreach programs

Education and Outreach Measures	Avg. Unit Cost ($)	Mattaponi IP Project Area	
		Units	Cost ($)
Septic System Education, homeowners and area realtors	5,250	3	15,750
Pet Waste Management Program	5,000	3	15,000
Organize Field Trips to Demonstrate Water Quality BMPs for Students	1,500	3	4,500
Organize "Farm Day" Events to Demonstrate Agricultural BMPs	2,250	3	6,750
Prepare Water Quality Educational Materials for Distribution at Farmer's Markets/Local Environmental Forums	4,500	3	13,500
Total		**-**	**55,500**

5.3.1.4 Farm Days

Many counties organize a farm day event to promote local farmers and provide an opportunity for residents to meet their local farmer and learn how their food is produced. These events are opportunities to highlight farms that have incorporated BMPs and can lead to increased local support for improved management practices.

5.3.1.5 Distribute Educational Materials at Farmers Markets

Farmers markets provide a great venue to inform stakeholders on water quality improvement measures. A booth can be setup a few times a year to distribute materials to local stakeholders.

Education and outreach funding needs are shown as a total for all IP watersheds, since the grantee organization(s) and geographic areas of future Section 319 grants is not known at this time.

5.4 Technical Assistance

The Technical Assistance program is important to the successful implementation of proposed management measures. With additional technical staff in the IP area local professionals can inform residents of the importance of protecting local water quality, increase awareness of the programs available to help with capital costs of installing management measures, and provide individual consultations with interested landowners. These efforts will assist in successful implementation of the management measures recommended to meet bacteria reductions targets over the 15-year planning horizon.

Education/outreach and technical assistance also provides an opportunity for residents and stakeholders to provide feedback for understanding what programs are working and whether adjustments will need to be made to meet reduction goals. As with education and outreach, technical assistance funding needs are shown for the entire IP project area, rather than individual IP watersheds. Technical assistance could be provided by future Section 319 grant recipients and other local environmental professionals, to landowners and producers within the project area.

Examples of the types of technical assistance that will be critical to successful implementation of the IP are meetings with individual agricultural producers to discuss conservation opportunities, with homeowners to discuss residential septic system maintenance needs, and with property owners and public organizations about improved stormwater management. From initial discussions, local environmental professionals can work directly with interested parties to explore specific BMPs opportunities and develop project plans.

As shown in Table 5-11, technical assistance activities are estimated for the IP project area as a whole, and would be eligible for inclusion in future Section 319 grants awarded through a competive Request for Applications process. As with education and outreach, in light of the large project area and number of potential grantees, the estimates are based on the assumption that up to three Section 319 grants could be active throughout plan implementation.

Table 5-12: Technical Assistance programs

Technical Assistance	**Avg. Unit Cost ($/FTE)**	**Mattaponi IP Project Area**	
		Units	**Cost ($)**
Technical Assistance –Agricultural and Residential/Developed Lands	60,000	22.5*	**1,350,000**

*Assumes up to three grants would be active throughout the 15 year implementation timeframe, with 0.5 FTE/year of TA in each grant

5.5 Summary of Recommended Implementation Actions

Table 5-12 provides a summary of the estimated costs of implementing individual programs by IP watershed. The greatest costs are estimated for addressing bacteria sources in the Po River IP watershed, which has the greatest composite of agricultural, residential septic, and developed land sources of bacteria. In contrast, the Chapel Creek watershed shows the lowest cost to address bacteria releases, with each of these source categories much smaller in scope.

Table 5-13: Summary of estimated cost of individual programs by IP watershed

BMP Category	Estimated Cost ($)								Total Cost ($)
	Chapel Creek	Maracossic Creek	Matta River	Mattaponi River	Po River	Polecat Creek	Poni River	Reedy Creek	
Livestock Exclusion/ Manure Management	192,000	512,000	493,000	732,000	523,000	285,000	425,000	345,000	**3,507,000**
Pasture and Cropland	347,993	1,546,930	641,817	729,528	1,121,355	304,351	443,909	79,508	**5,215,391**
Equine	12,000	21,000	36,000	36,000	36,000	33,000	36,000	24,000	**234,000**
Septic Systems	404,400	1,725,700	2,532,500	3,021,100	3,283,300	1,659,900	3,127,500	605,900	**16,360,300**
Pet Waste	13,110	127,010	86,760	155,255	192,665	54,915	91,730	9,490	**730,935**
Stormwater	87,510	364,740	438,970	592,090	1,198,950	1,286,220	1,340,510	280,150	**5,589,140**
Education and Outreach	-	-	-	-	-	-	-	-	**55,500**
Technical Assistance	-	-	-	-	-	-	-	-	**1,350,000**
Total Cost	**1,525,513***	**4,297,380**	**4,229,047**	**5,734,473***	**6,823,770***	**3,623,386**	**5,464,649**	**1,344,048**	**33,042,266**

* Total costs for the Chapel Creek, Matta River and Mattaponi River IP watersheds include one-third of the Education and Outreach and Technical Assistance costs to allow IP watershed totals to sum to the total cost for entire IP.

6 Cost of Implementation

As discussed in Chapter 5, the costs of BMPs recommended in this plan are based on a variety of sources that represent the best available information on costs to carry out the recommended management practices. The estimated cost of measures recommended as part of Phase I come to $20.24 million, and the additional measures that constitute Phase II of this IP cost another $18.47 million.

Water quality modeling shows that completion of the Phase I BMP targets will result in achievement of the *E. coli* geometric mean value criterion of 126 cfu/100 mL in all IP watersheds. Completion of the Phase II BMP targets will result in achievement of less than a 10.5 percent exceedance rate of the maximum assessment criterion of 235 cfu/100mL for impaired streams within the entire IP project area.

Total costs of the measures recommended based on water quality modeling and stakeholder consultations are estimated to be $34.4 million. These cost estimates are summarized for agricultural, residential, and developed land measures in Table 6-1. BMP unit costs were shown for each measure in Table 5-2 above, and BMP costs by implementation phase are shown in Table 8-2.

Table 6-1: Estimated cost of recommended agricultural and residential management actions by IP watershed

IP Area	Agricultural BMPs	Residential Septic BMPs	Developed Lands BMPs *	TOTAL**
Chapel Creek	551,993	404,400	100,620	**1,057,013**
Maracossic Creek	2,079,930	1,725,700	491,750	**4,297,380**
Matta River	1,170,817	2,532,500	525,730	**4,229,047**
Mattaponi River	1,497,528	3,021,100	747,345	**5,265,973**
Po River	1,680,355	3,283,300	1,391,615	**6,355,270**
Polecat Creek	622,351	1,659,900	1,341,135	**3,623,386**
Poni River	904,909	3,127,500	1,432,240	**5,464,649**
Reedy Creek	448,508	605,900	289,640	**1,344,048**
Total	**8,956,391**	**16,360,300**	**6,320,075**	**33,042,266****

* Pet Waste management measures ($735K) are included with Developed Lands BMPs in this table

** Includes $55,500 in Educations and Outreach and $1,350,000 in technical assistance.

7 Benefits

The primary benefit of this plan is to reduce the amount of bacteria in the impaired streams sufficient to meet the water quality standards, restoring the recreational use of the waterway. Resolving the bacteria impairment, however, will improve more than just pollution from bacteria. Numerous direct and indirect improvements made through implementation of the management measures include economic benefits to local agricultural producers, improved ecosystem health and habitat creation, cleaner drinking water sources, enhanced recreation and tourism sectors of the local economy, and a more engaged, proactive community.

Further, the measures implemented as a part of this IP will have the added benefit of reducing pollutants reaching the Chesapeake Bay and thus make progress towards achieving the Chesapeake Bay TMDL goals. The Bay TMDL focuses on impairments caused by excess sediment and nutrient (nitrogen and phosphorus) pollutant inputs to the Chesapeake Bay. Many of the BMPs recommended in this "local" IP to reduce bacteria will also reduce sediment and nutrient discharges. For example, Agricultural BMPs that create riparian buffers or improve crop or pasture land management will reduce sediments and nutrients carried by stormwater runoff from agricultural lands into local streams that ultimately drain into the Chesapeake Bay. Similarly, maintaining, repairing or replacing failing septic systems will reduce nitrogen discharges to local streams (and the Bay). Addressing stormwater runoff from developed lands can reduce both sediment and nutrient runoff, some of which would otherwise reach the Chesapeake Bay.

The benefits of agricultural, residential, and education and outreach practices are discussed in more detail in the sections below.

7.1 Agricultural Practices

Agricultural management measures (e.g. livestock exclusion, pasture and cropland, and equine practices) have numerous potential benefits in addition to reducing instream bacteria. Keeping livestock out of the stream through installation of watering systems, stream fencing and crossings, riparian buffers, and other measures has the added benefit of preventing the spread of cattle diseases like *E. coli*, salmonella, leptospirosis, and mastitis (Nordstrom 2016). Additional livestock benefits of increased access to clean water can include weight gain, increased milk production, and decreased foot rot. Distributing water systems across pasture increases forage utilization which improves cattle productivity and, in some cases, may allow farmers to increase animal density (Zeckoski et al., 2007). Pasture and cropland management measures can increase profitability for the producer by reducing the amount of purchased feed required (DEQ 2016c).

Implementing improved pasture management systems, in conjunction with installing clean water supplies, provides economic benefits for the producer. Improved pasture management can allow a producer to feed less hay in winter months, increase stocking rates by 30 to 40 percent, and improve the profitability of the operation. With feed costs typically responsible for 70 to 80 percent of the cost of growing or maintaining an animal, increasing the amount of time that cattle are fed on pasture is a financial benefit to producers (Virginia Cooperative Extension, 1996). In addition to reducing costs to producers, intensive pasture management can boost profits by allowing higher stocking rates.

Stabilizing streambanks, installing sediment retention structures, and creating vegetative buffers can reduce pollutant transport to the stream, thereby improving aquatic habitat. These measures also create and/or improve existing aquatic and terrestrial wildlife habitats, while directly addressing the additional water quality impairments caused by excess sediment releases. The co-benefits of sediment reduction provided by some BMPs recommended to reduce bacteria, will help to address the local stream segments (Herring, Polecat, and Reedy Creek, and the Matta and Ni River) that are impaired for aquatic life use, as well as support sediment reduction goals of the Chesapeake Bay TMDL.

Vegetated buffers established from the installation of stream fencing reduce sediment and nutrient transport to the stream from upslope locations. These pollutants have been identified as the major stressors to benthic aquatic communities in the benthic TMDLs completed in Virginia to date. While stream exclusion fencing placed at the top of the stream bank would reduce the bacteria loading from cattle in the stream, the additional benefit of reducing sediment and nutrient loadings from the upland would be lost without the riparian buffer. Streamside buffers of trees and shrubs help reduce erosion and provide shading of the stream. This helps keep water temperatures lower during the summer and allows for a greater amount of dissolved oxygen in the stream, which is beneficial for macroinvertebrates and fish.

Excessive sediment clogs the spaces in between river bed substrate that usually provides habitat for benthic macroinvertebrates, ultimately smothering and killing the invertebrate flora within that portion of a stream (Harrison et al., 2007). As excessive sedimentation begins to alter the macroinvertebrate community, some taxa will not be able to survive. The macroinvertebrate community serves as a major food source for freshwater fish. If their community is altered, there is potential for this to affect the fishery as well. Thus, the health of the whole aquatic ecosystem is dependent in part upon its physical habitat. Healthy fisheries will in turn provide more stock for local anglers. In 2011 alone, approximately $3.5 billion was spent on wildlife recreation in Virginia (US Department of the Interior et al., 2011). Buffers can also improve habitat for wildlife and migratory songbirds that also benefit from having access to a healthy, thriving aquatic community.

7.2 Residential and Developed Land Practices

Residential measures like repair and replacement of septic systems, implementation of pet waste controls, and developed land stormwater management efforts have a number of benefits in addition to bacteria reductions. Proper septic tank maintenance extends the life of the system, which saves homeowners money in the long-run. Improved pet waste reduces the transport of bacteria to local streams, while enhancing community aesthetics. Better stormwater management reduces the transport of bacteria and other pollutants downstream, while also reducing localized flooding concerns.

Residential septic system implementation programs play an important role in improving water quality by reducing waterway pollution from human waste and the viruses, bacteria, and protozoan pathogens it can potentially carry. While it is hard to gauge the specific impact that reducing bacteria contamination will have on public health, the chances of infection from *E. coli* sources through contact with surface waters in streams should be considerably reduced. Throughout the United States, the Centers for Disease Control (CDC) estimates that at least 73,000 cases of illness and 61 deaths per year are caused by *E. coli* 0157:H7 bacteria (CDC, 2001).

Implementation of residential septic system BMPs will help convey to homeowners the knowledge and tools needed to properly maintain and extend the life of their septic systems. The average septic system will last 20-25 years, if properly maintained, and the cost of this maintenance is relatively inexpensive compared to the costs to repair or replace a septic system.

Property owners can mitigate flood water damages and any associated costs by installing infiltration BMPs such as rain gardens and vegetated swales. At an individual residential scale, rain gardens can reduce water runoff from lots while supporting attractive plantings. Johnston et al. (2006) applied two different methods (one cost-based and one value-based) for estimating economic benefits of employing conservation design practices (vegetated swales, green roofs, permeable pavers, and native vegetation). The researchers found quantifiable economic benefits to property values downstream of areas where conservation practices were implemented. Residential measures also encourage community involvement and education, which is discussed below.

At a larger scale, riparian buffers, constructed or restored wetlands, and wet ponds can all reduce stormwater runoff that carries bacteria and excess sediments and nutrients to local streams (and the Chesapeake Bay). Wetlands in particular can have a broad suite of ecological services, including pollution mitigation, that improve water quality and habitat values of adjacent aquatic resources. Stormwater infrastructure that reduces stormwater runoff on-site can reduce losses from flood damage by $6,700-$9,700 per acre (Medina et al., 2011).

7.3 Education and Outreach

Participation of a wide range of local stakeholders will be required to fully implement the plan and achieve water quality goals. This wide-reaching involvement necessitates education and outreach. By providing the local community with awareness of the problem, knowledge of the issues, and an appreciation of the actions that need to be taken, the community is more likely to take and support actions to address both current and future environmental problems (Hungerford and Volk 1990). Increased public engagement in local water quality management can be a stepping stone to broader and sustained efforts by community members to address other local and regional challenges and opportunities.

8 Measurable Goals and Milestones for Attaining Water Quality Standards

Delisting the impaired waters in the plan area is the ultimate goal of this implementation plan. Currently there are 18 stream segments within the IP project area that are impaired for recreational uses due to excess bacteria levels. These water segments ("assessment units") within the plan area will continue to be monitored for *E. coli* in accordance with DEQ's monitoring strategy to determine if water quality conditions are improving. Once monitoring indicates progress towards meeting interim water quality goals, it will be recommended for intensive monitoring so its status relative to the applicable bacteria standards can be determined. As has been noted, the bacteria reductions associated with the recommended BMPs align with the water quality standards in place at the time the TMDL report was developed. Future water quality assessment decisions (including delisting of the currently impaired stream segments) will be based on the water quality standards in place at that time.

As noted, the IP will be carried out in two phases. Phase I covers the first ten years of implementation (Years 1-10), and the BMPs recommended in Phase I were initially designed to meet the *E. coli* criterion, as measured by a geometric mean value of 126 cfu/100 mL of water using the most cost-effective measures to achieve improvements in water quality. The initially modeled Phase I BMPs were adjusted by folding in some additional BMPs, such as equine composting and wetlands restoration that were of special interest to local stakeholders, while moving some initial Phase I BMPs into Phase II.

Modeling of the final Phase I BMPs shows these will result in achieving the geometric mean criterion level for *E. coli* bacteria in all impaired streams. With the exception of the Reedy Creek IP watershed, additional BMPs are required during Phase II (Years 11-15) to achieve less than a 10.5 percent exceedance level of the maximum assessment criterion value of 235 cfu/100mL in all impaired streams in the IP watersheds. The maximum assessment criterion is more challenging to achieve during dry weather flow regimes because runoff-based controls are not effective in reducing bacteria loads during the dry weather periods, and the bacteria loads from point sources, failed septic systems and direct depositions remain relatively constant over time.

Management measures by implementation phase are shown in Table 8-1. The costs for phased implementation of the plan are summarized in Table 8-2 and the number of units needed in each phase of implementation is provided in Table 8-3.

Progress toward end goals can be assessed during the implementation process through tracking of control measure installations and continued water quality monitoring. The implementation timeline is divided into two phases with two types of milestones, implementation milestones and water quality milestones. Implementation milestones establish the percentage of implementation actions installed within specified timeframes. Water quality milestones establish the corresponding improvements in water quality that is expected as the implementation milestones are met. These two milestone types are inextricably linked because the implementation of proposed management measures is expected to improve water quality by predictable increments.

Table 8-1: Management measure by implementation phase

Control Measure	Chapel Creek	Maracossic Creek	Matta River	Mattaponi River	Po River	Polecat Creek	Poni River	Reedy Creek
Livestock Exclusion								
CREP Livestock Exclusion (CREP, CRSL-6)	I	I & II	I & II	I & II	I & II	I	I & II	I
Stream Exclusion with Grazing Land Management (SL-6)	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I
Livestock Exclusion with Reduced Setback (LE-2 / LE-2T)	I & II	I & II	I & II	I & II	I & II	I	I	I
Stream Protection (WP-2 / WP-2T)	I & II	I & II	I & II	I & II	I & II	I	I	I
Livestock Exclusion with Riparian Buffers (LE-1T)	I	I	I	I	I	I	I	I
Pasture and Cropland								
Pasture Management for TMDL Implementation (SL-10T / EQIP 528)	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I
Permanent Vegetative Cover on Critical Areas (SL-11)	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I
Sediment Retention, Erosion, or Water Control Structure (WP-1)	II	II	II	II	II	II	II	-
Grass Riparian Buffers (WQ-1)	I	I	I	I	I	I	I	I
Woodland Filter Buffer Area (FR-3)	I	I	I	I	I	I	I	I
Conservation Tillage (SL-15A)	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I
Permanent Vegetative Cover on Cropland (SL-1)	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I
Sod Waterway (WP-3)	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I
Small Grain and Mixed Cover Crop (SL-8B)	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I
Equine								
Small Acreage Grazing System (SL-6AT)	I	I	I	I	I	I	I	I
Small Scale Manure Composting for Equine Operations – Static Systems (EM-1T)	I	I	I	I	I	I	I	I

Control Measure	Chapel Creek	Maracossic Creek	Matta River	Mattaponi River	Po River	Polecat Creek	Poni River	Reedy Creek
Sewage Systems								
Alternative Waste Treatment System (RB-5)	I	I	I	I	I	I	I	I
Connection to Public Sewer (RB-2)	-	I	I	I	I	I	I	I
Septic System Pump-Out (RB-1)	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I
Repair Septic System (RB-3)	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I
Septic System Installation/Replacement (RB-4)	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I
Pet Waste Management								
Pet Waste Disposal Station (PW-1)	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I
Pet Waste Composter, Digester and Fermentation (PW-2)	I	I & II	I & II	I & II	I & II	I & II	I & II	I
Stormwater Management								
Rain Garden	II	II	II	II	I & II	II	I & II	I
Constructed Wetland	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I
Wet Pond	II	II	II	I & II	I & II	I & II	I & II	I
Riparian Buffer – Grass/Shrub	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I
Wetland Restoration	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I

Table 8-2: Cost breakdown by implementation phase

Control Measure	Phase I Cost ($)	Phase II Cost ($)	Total ($)	Phase I Cost ($)	Phase II Cost ($)	Total ($)	Phase I Cost ($)	Phase II Cost ($)	Total ($)
	Chapel Creek			Maracossic Creek			Matta River		
Livestock Exclusion									
CREP Livestock Exclusion (CREP, CRSL-6)	30,000	-	30,000	120,000	30,000	150,000	150,000	30,000	180,000
Stream Exclusion with Grazing Land Management (SL-6)	25,000	25,000	50,000	75,000	25,000	100,000	100,000	25,000	125,000
Livestock Exclusion with Reduced Setback (LE-2 / LE-2T)	17,000	17,000	34,000	68,000	17,000	85,000	51,000	17,000	68,000
Stream Protection (WP-2 / WP-2T)	21,000	21,000	42,000	84,000	21,000	105,000	63,000	21,000	84,000
Livestock Exclusion with Riparian Buffers (LE-1T)	36,000	-	36,000	72,000	-	72,000	36,000	-	36,000
Total ($), Livestock Exclusion/Manure Management	**129,000**	**63,000**	**192,000**	**419,000**	**93,000**	**512,000**	**400,000**	**93,000**	**493,000**
Pasture and Cropland									
Pasture Management for TMDL Implementation (SL-10T / EQIP 528)	11,593	34,779	46,372	72,902	218,706	291,608	48,043	144,128	192,171
Permanent Vegetative Cover on Critical Areas (SL-11)	15,457	46,372	61,829	52,073	156,218	208,291	27,453	82,359	109,812
Sediment Retention, Erosion, or Water Control Structure (WP-1)	-	19,322	19,322	-	130,182	130,182	-	82,359	82,359
Grass Riparian Buffers (WQ-1)	1,750	-	1,750	7,350	-	7,350	8,225	-	8,225
Woodland Filter Buffer Area (FR-3)	3,150	-	3,150	14,400	-	14,400	12,600	-	12,600
Conservation Tillage (SL-15A)	17,136	51,408	68,544	81,991	245,972	327,963	23,858	71,574	95,432
Permanent Vegetative Cover on Cropland (SL-1)	20,992	62,975	83,966	104,988	314,965	419,953	24,852	74,557	99,409
Sod Waterway (WP-3)	13,709	41,126	54,835	31,996	95,989	127,986	9,089	27,266	36,355

Continued to next IP watersheds

Control Measure	Phase I Cost ($)	Phase II Cost ($)	Total ($)	Phase I Cost ($)	Phase II Cost ($)	Total ($)	Phase I Cost ($)	Phase II Cost ($)	Total ($)
Small Grain and Mixed Cover Crop (SL-8B)	2,056	6,169	8,225	4,799	14,398	19,198	1,363	4,090	5,453
	Chapel Creek			Maracossic Creek			Matta River		
Total ($), Pasture and Cropland	**85,843**	**262,150**	**347,993**	**370,500**	**1,176,431**	**1,546,931**	**155,483**	**486,333**	**641,816**
Equine Management									
Small Acreage Grazing System (SL-6AT)	9,000	-	9,000	18,000	-	18,000	27,000	-	27,000
Small Scale Manure Composting for Equine Operations – Static Systems (EM-1T)	20,000	-	20,000	20,000	-	20,000	60,000	-	60,000
Total ($), Equine Management	**29,000**	**-**	**29,000**	**38,000**	**-**	**38,000**	**87,000**	**-**	**87,000**
Sewage Systems									
Alternative Waste Treatment System (RB-5)	24,000	-	24,000	48,000	-	48,000	48,000	-	48,000
Connection to Public Sewer (RB-2)	-	-	-	55,000	-	55,000	66,000	-	66,000
Septic System Pump-Out (RB-1)	87,300	29,100	116,400	321,525	107,175	428,700	379,125	126,375	505,500
Repair Septic System (RB-3)	180,000	60,000	240,000	877,500	292,500	1,170,000	1,398,750	466,250	1,865,000
Septic System Installation/Replacement (RB-4)	18,000	6,000	24,000	18,000	6,000	24,000	36,000	12,000	48,000
Total ($), Sewage Systems	**309,300**	**95,100**	**404,400**	**1,320,025**	**405,675**	**1,725,700**	**1,927,875**	**604,625**	**2,532,500**
Pet Waste Management									
Pet Waste Disposal Station (PW-1)	8,140	4,070	12,210	81,400	32,560	113,960	48,840	24,420	73,260
Pet Waste Composter, Digester and Fermentation (PW-2)	900	-	900	9,900	3,150	13,050	10,125	3,375	13,500
Total ($), Pet Waste	**9,040**	**4,070**	**13,110**	**91,300**	**35,710**	**127,010**	**58,965**	**27,795**	**86,760**
Stormwater BMPs									
Rain Garden	-	5,000	5,000	-	10,000	10,000	-	10,000	10,000

Control Measure	Phase I Cost ($)	Phase II Cost ($)	Total ($)	Phase I Cost ($)	Phase II Cost ($)	Total ($)	Phase I Cost ($)	Phase II Cost ($)	Total ($)
Constructed Wetland	2,900	11,600	14,500	26,100	69,600	95,700	43,500	127,600	171,100
	Chapel Creek			**Maracossic Creek**			**Matta River**		
Wet Pond	-	8,350	8,350	-	16,700	16,700	-	25,050	25,050
Riparian Buffer – Grass/Shrub	11,880	35,280	47,160	39,960	119,880	159,840	16,920	68,400	85,320
Wetland Restoration	2,500	10,000	12,500	22,500	60,000	82,500	37,500	110,000	147,500
Total ($), Stormwater BMPs	**17,280**	**70,230**	**87,510**	**88,560**	**276,180**	**364,740**	**97,920**	**341,050**	**438,970**
	Mattaponi River			**Po River**			**Polecat Creek**		
Livestock Exclusion									
CREP Livestock Exclusion (CREP, CRSL-6)	180,000	30,000	210,000	150,000	30,000	180,000	60,000	-	60,000
Stream Exclusion with Grazing Land Management (SL-6)	125,000	25,000	150,000	75,000	25,000	100,000	50,000	25,000	75,000
Livestock Exclusion with Reduced Setback (LE-2 / LE-2T)	119,000	34,000	153,000	85,000	17,000	102,000	51,000	-	51,000
Stream Protection (WP-2 / WP-2T)	126,000	21,000	147,000	84,000	21,000	105,000	63,000	-	63,000
Livestock Exclusion with Riparian Buffers (LE-1T)	72,000	-	72,000	36,000	-	36,000	36,000	-	36,000
Total ($), Livestock Exclusion/Manure Management	**622,000**	**110,000**	**732,000**	**430,000**	**93,000**	**523,000**	**260,000**	**25,000**	**285,000**
Pasture and Cropland									
Pasture Management for TMDL Implementation (SL-10T / EQIP 528)	31,138	93,413	124,550	103,029	309,087	412,116	15,324	45,972	61,296
Permanent Vegetative Cover on Critical Areas (SL-11)	31,138	93,413	124,550	41,212	123,635	164,846	15,324	45,972	61,296

Continued

Control Measure	Phase I Cost ($)	Phase II Cost ($)	Total ($)	Phase I Cost ($)	Phase II Cost ($)	Total ($)	Phase I Cost ($)	Phase II Cost ($)	Total ($)
Sediment Retention, Erosion, or Water Control Structure (WP-1)	-	54,491	54,491	-	154,544	154,544	-	19,155	19,155
Grass Riparian Buffers (WQ-1)	13,300	-	13,300	14,700	-	14,700	2,100	-	2,100
	Mattaponi River			Po River			Polecat Creek		
Woodland Filter Buffer Area (FR-3)	13,500	-	13,500	16,650	-	16,650	3,600	-	3,600
Conservation Tillage (SL-15A)	45,425	136,276	181,701	40,857	122,570	163,427	15,228	45,683	60,910
Permanent Vegetative Cover on Cropland (SL-1)	26,498	79,494	105,992	35,100	105,299	140,399	12,791	38,373	51,164
Sod Waterway (WP-3)	24,227	72,680	96,907	11,886	35,657	47,542	9,746	29,237	38,982
Small Grain and Mixed Cover Crop (SL-8B)	3,634	10,902	14,536	1,783	5,349	7,131	1,462	4,386	5,847
Total ($), Pasture and Cropland	**188,859**	**540,669**	**729,528**	**265,215**	**856,140**	**1,121,355**	**75,574**	**228,777**	**304,351**
Equine Management									
Small Acreage Grazing System (SL-6AT)	27,000	-	27,000	27,000	-	27,000	27,000	-	27,000
Small Scale Manure Composting for Equine Operations – Static Systems (EM-1T)	9,000	-	9,000	9,000	-	9,000	6,000	-	6,000
Total ($), Equine Management	**36,000**	**-**	**36,000**	**36,000**	**-**	**36,000**	**33,000**	**-**	**33,000**
Sewage Systems									
Alternative Waste Treatment System (RB-5)	72,000	-	72,000	72,000	-	72,000	216,000	-	216,000
Connection to Public Sewer (RB-2)	110,000	-	110,000	110,000	-	110,000	55,000	-	55,000
Septic System Pump-Out (RB-1)	629,325	209,775	839,100	645,975	215,325	861,300	342,675	114,225	456,900
Repair Septic System (RB-3)	1,440,000	480,000	1,920,000	1,620,000	540,000	2,160,000	645,000	215,000	860,000
Septic System Installation/Replacement (RB-4)	60,000	20,000	80,000	56,000	24,000	80,000	48,000	24,000	72,000

Control Measure	Phase I Cost ($)	Phase II Cost ($)	Total ($)	Phase I Cost ($)	Phase II Cost ($)	Total ($)	Phase I Cost ($)	Phase II Cost ($)	Total ($)
Total ($), Sewage Systems	**2,311,325**	**709,775**	**3,021,100**	**2,503,975**	**779,325**	**3,283,300**	**1,306,675**	**353,225**	**1,659,900**
Pet Waste Management									
Pet Waste Disposal Station (PW-1)	105,820	32,560	138,380	113,960	36,630	150,590	36,630	12,210	48,840
	Mattaponi River			**Po River**			**Polecat Creek**		
Pet Waste Composter, Digester and Fermentation (PW-2)	12,600	4,275	16,875	31,500	10,575	42,075	4,500	1,575	6,075
Total ($), Pet Waste	**118,420**	**36,835**	**155,255**	**145,460**	**47,205**	**192,665**	**41,130**	**13,785**	**54,915**
Stormwater BMPs									
Rain Garden	-	10,000	10,000	5,000	15,000	20,000	-	15,000	15,000
Constructed Wetland	31,900	98,600	130,500	87,000	339,300	426,300	89,900	182,700	272,600
Wet Pond	25,050	100,200	125,250	50,100	158,650	208,750	217,100	434,200	651,300
Riparian Buffer – Grass/Shrub	51,840	162,000	213,840	39,600	136,800	176,400	37,800	74,520	112,320
Wetland Restoration	27,500	85,000	112,500	75,000	292,500	367,500	77,500	157,500	235,000
Total ($), Stormwater BMPs	**136,290**	**455,800**	**592,090**	**256,700**	**942,250**	**1,198,950**	**422,300**	**863,920**	**1,286,220**
	Poni River			**Reedy Creek**			**All IP watersheds Combined**		
Livestock Exclusion									
CREP Livestock Exclusion (CREP, CRSL-6)	120,000	30,000	150,000	120,000	-	120,000	930,000	150,000	1,080,000
Stream Exclusion with Grazing Land Management (SL-6)	100,000	25,000	125,000	75,000	-	75,000	625,000	175,000	800,000
Livestock Exclusion with Reduced Setback (LE-2 / LE-2T)	51,000	-	51,000	51,000	-	51,000	493,000	102,000	595,000
Stream Protection (WP-2 / WP-2T)	63,000	-	63,000	63,000	-	63,000	567,000	105,000	672,000

Control Measure	Phase I Cost ($)	Phase II Cost ($)	Total ($)	Phase I Cost ($)	Phase II Cost ($)	Total ($)	Phase I Cost ($)	Phase II Cost ($)	Total ($)
Livestock Exclusion with Riparian Buffers (LE-1T)	36,000	-	36,000	36,000	-	36,000	360,000	-	360,000
Total ($), Livestock Exclusion/Manure Management	**370,000**	**55,000**	**425,000**	**345,000**	**-**	**345,000**	**2,975,000**	**532,000**	**3,507,000**
Pasture and Cropland									
	Poni River			**Reedy Creek**			**All IP watersheds Combined**		
Pasture Management for TMDL Implementation (SL-10T / EQIP 528)	29,546	88,639	118,185	10,560	-	10,560	322,134	934,723	1,256,858
Permanent Vegetative Cover on Critical Areas (SL-11)	23,637	70,911	94,548	21,600	-	21,600	227,893	618,880	846,773
Sediment Retention, Erosion, or Water Control Structure (WP-1)	-	59,093	59,093	-	-	-	-	519,144	519,144
Grass Riparian Buffers (WQ-1)	4,900	-	4,900	2,800	-	2,800	55,125	-	55,125
Woodland Filter Buffer Area (FR-3)	9,450	-	9,450	3,600	-	3,600	76,950	-	76,950
Conservation Tillage (SL-15A)	16,228	48,683	64,911	12,958	-	12,958	253,680	722,166	975,847
Permanent Vegetative Cover on Cropland (SL-1)	13,253	39,758	53,011	12,094	-	12,094	250,568	715,420	965,988
Sod Waterway (WP-3)	8,655	25,964	34,619	13,822	-	13,822	123,129	327,920	451,049
Small Grain and Mixed Cover Crop (SL-8B)	1,298	3,895	5,193	2,073	-	2,073	18,469	49,188	67,657
Total ($), Pasture and Cropland	**106,967**	**336,943**	**443,910**	**79,508**	**-**	**79,508**	**1,327,949**	**3,887,443**	**5,215,392**
Equine Management									
Small Acreage Grazing System (SL-6AT)	27,000	-	27,000	18,000	-	18,000	180,000	-	180,000
Small Scale Manure Composting for Equine Operations – Static Systems (EM-1T)	9,000	-	9,000	6,000	-	6,000	54,000	-	54,000

Control Measure	Phase I Cost ($)	Phase II Cost ($)	Total ($)	Phase I Cost ($)	Phase II Cost ($)	Total ($)	Phase I Cost ($)	Phase II Cost ($)	Total ($)	
Total ($), Equine Management	**36,000**	**-**	**36,000**	**24,000**	**-**	**24,000**	**234,000**	**-**	**234,000**	
Sewage Systems										
Alternative Waste Treatment System (RB-5)	72,000	-	72,000	48,000	-	48,000	600,000	-	600,000	
Connection to Public Sewer (RB-2)	110,000	-	110,000	11,000	-	11,000	517,000	-	517,000	
Septic System Pump-Out (RB-1)	716,625	238,875	955,500	219,900	-	219,900	3,342,450	1,040,850	4,383,300	
	Poni River			**Reedy Creek**			**All IP watersheds Combined**			
Repair Septic System (RB-3)	1,432,500	477,500	1,910,000	295,000	-	295,000	7,888,750	2,531,250	10,420,000	
Septic System Installation/Replacement (RB-4)	56,000	24,000	80,000	32,000	-	32,000	324,000	116,000	440,000	
Total ($), Sewage Systems	**2,387,125**	**740,375**	**3,127,500**	**605,900**	**-**	**605,900**	**12,672,200**	**3,688,100**	**16,360,300**	
Pet Waste Management										
Pet Waste Disposal Station (PW-1)	56,980	20,350	77,330	8,140	-	8,140	459,910	162,800	622,710	
Pet Waste Composter, Digester and Fermentation (PW-2)	10,800	3,600	14,400	1,350	-	1,350	81,675	26,550	108,225	
Total ($), Pet Waste	**67,780**	**23,950**	**91,730**	**9,490**	**-**	**9,490**	**541,585**	**189,350**	**730,935**	
Stormwater BMPs										
Rain Garden	30,000	100,000	130,000	5,000	-	5,000	40,000	165,000	205,000	
Constructed Wetland	95,700	348,000	443,700	58,000	-	58,000	435,000	1,177,400	1,612,400	
Wet Pond	25,050	83,500	108,550	141,950	-	141,950	459,250	826,650	1,285,900	
Riparian Buffer – Grass/Shrub	59,760	216,000	275,760	25,200	-	25,200	282,960	812,880	1,095,840	
Wetland Restoration	82,500	300,000	382,500	50,000	-	50,000	375,000	1,015,000	1,390,000	

Control Measure	Phase I Cost ($)	Phase II Cost ($)	Total ($)	Phase I Cost ($)	Phase II Cost ($)	Total ($)	Phase I Cost ($)	Phase II Cost ($)	Total ($)	
Total ($), Stormwater BMPs	293,010	1,047,500	1,340,510	280,150	-	280,150	1,592,210	3,996,930	5,589,140	
Education and Outreach Measures										
Septic System Education, homeowners and area realtors	-	-	-	-	-	-	15,750	-	**15,750**	
Pet Waste Management Program	-	-	-	-	-	-	15,000	-	**15,000**	
Organize Field Trips to Demonstrate Water Quality BMPs for Students	-	-	-	-	-	-	4,500	-	**4,500**	
Organize Farm Day Events to Demonstrate Agricultural BMPs	-	-	-	-	-	-	6,750	-	**6,750**	
	Poni River			**Reedy Creek**			**All IP watersheds Combined**			
Prepare Water Quality Educational Materials for Distribution at Farmer's Markets/Local Environmental Forums	-	-	-	-	-	-	13,500	-	**13,500**	
Total ($), Education and Outreach Measures	**-**	**-**	**-**	**-**	**-**	**-**	**55,500**	**-**	**55,500**	
Technical Assistance										
Technical Assistance, Agricultural and Residential/Developed Lands	-	-	-	-	-	-	900,000	450,000	**1,350,000**	
Total Technical Assistance	**-**	**-**	**-**	**-**	**-**	**-**	**900,000**	**450,000**	**1,350,000**	
Total Cost							**20,298,444**	**12,743,823**	**33,042,267**	

Table 8-3: Number of management measure units per phase by IP watershed

Control Measure	Phase I Units	Phase II Units	Phase I Units	Phase II Units	Phase I Units	Phase II Units	Phase I Units	Phase II Units	Total Phase I Units	Total Phase II Units
	Chapel Creek		Maracossic Creek		Matta River		Mattaponi River			
Livestock Exclusion										Continued to next IP watersheds
CREP Livestock Exclusion (CREP, CRSL-6)	1	-	4	1	5	1	6	1		
Stream Exclusion with Grazing Land Management (SL-6)	1	1	3	1	4	1	5	1		
Livestock Exclusion with Reduced Setback (LE-2 / LE-2T)	1	1	4	1	3	1	7	2		
Stream Protection (WP-2 / WP-2T)	1	1	4	1	3	1	6	1		
Livestock Exclusion with Riparian Buffers (LE-1T)	1	-	2	-	1	-	2	-		
Pasture and Cropland										
Pasture Management for TMDL Implementation (SL-10T / EQIP 528)	97	290	608	1,823	400	1,201	259	778		
Permanent Vegetative Cover on Critical Areas (SL-11)	13	39	43	130	23	69	26	78		
Sediment Retention, Erosion, or Water Control Structure (WP-1)	-	129	-	868	-	549	-	363		
Grass Riparian Buffers (WQ-1)	10	-	42	-	47	-	76	-		
Woodland Filter Buffer Area (FR-3)	7	-	32	-	28	-	30	-		
Conservation Tillage (SL-15A)	171	514	820	2,460	239	716	454	1,363		
Permanent Vegetative Cover on Cropland (SL-1)	120	360	600	1,800	142	426	151	454		
Sod Waterway (WP-3)	9	26	20	60	6	17	15	45		
Small Grain and Mixed Cover Crop (SL-8B)	43	129	100	300	28	85	76	227		

Control Measure	Phase I Units	Phase II Units	Phase I Units	Phase II Units	Phase I Units	Phase II Units	Phase I Units	Phase II Units	Total Phase I Units	Total Phase II Units
	Chapel Creek		Maracossic Creek		Matta River		Mattaponi River			
Equine Management										
Small Acreage Grazing System (SL-6AT)	1	-	2	-	3	-	3	-		
Small Scale Manure Composting for Equine Operations – Static Systems (EM-1T)	1	-	1	-	3	-	3	-		
Sewage Systems										
Alternative Waste Treatment System (RB-5)	1	-	2	-	2	-	3	-		
Connection to Public Sewer (RB-2)	-	-	5	-	6	-	10	-		
Septic System Pump-Out (RB-1)	291	97	1,072	357	1,264	421	2,098	699		
Repair Septic System (RB-3)	36	12	176	59	280	93	288	96		
Septic System Installation/Replacement (RB-4)	2	1	2	1	5	2	8	3		
Pet Waste Management										
Pet Waste Disposal Station (PW-1)	2	1	20	8	12	6	26	8		
Pet Waste Composter, Digester and Fermentation (PW-2)	4	-	44	15	45	15	56	19		
Stormwater BMPs										
Rain Garden	-	1	-	2	-	2	-	2		
Constructed Wetland	1	4	9	24	15	44	11	34		
Wet Pond	-	1	-	2	-	3	3	12		
Riparian Buffer – Grass/Shrub	33	98	111	333	47	190	144	450		
Wetland Restoration	1	4	9	24	15	44	11	34		

Control Measure	Phase I Units	Phase II Units	Phase I Units	Phase II Units	Phase I Units	Phase II Units	Phase I Units	Phase II Units	Total Phase I Units	Total Phase II Units
	Po River		Polecat Creek		Poni River		Reedy Creek		All IP watersheds	
Livestock Exclusion										
CREP Livestock Exclusion (CREP, CRSL-6)	5	1	2	-	4	1	4	-	31	5
Stream Exclusion with Grazing Land Management (SL-6)	3	1	2	1	4	1	3	-	25	7
Livestock Exclusion with Reduced Setback (LE-2 / LE-2T)	5	1	3	-	3	-	3	-	29	6
Stream Protection (WP-2 / WP-2T)	4	1	3	-	3	-	3	-	27	5
Livestock Exclusion with Riparian Buffers (LE-1T)	1	-	1	-	1	-	1	-	10	-
Pasture and Cropland										
Pasture Management for TMDL Implementation (SL-10T / EQIP 528)	859	2,576	128	383	246	739	88	-	2,685	7,789
Permanent Vegetative Cover on Critical Areas (SL-11)	34	103	13	38	20	59	18	-	190	516
Sediment Retention, Erosion, or Water Control Structure (WP-1)	-	1,030	-	128	-	394	-	-	-	3,461
Grass Riparian Buffers (WQ-1)	84	-	12	-	28	-	16	-	315	-
Woodland Filter Buffer Area (FR-3)	37	-	8	-	21	-	8	-	171	-
Conservation Tillage (SL-15A)	409	1,226	152	457	162	487	130	-	2,537	7,222

Control Measure	Phase I Units	Phase II Units	Phase I Units	Phase II Units	Phase I Units	Phase II Units	Phase I Units	Phase II Units	Total Phase I Units	Total Phase II Units
	Po River		Polecat Creek		Poni River		Reedy Creek		All IP watersheds	
Permanent Vegetative Cover on Cropland (SL-1)	201	602	73	219	76	227	69	-	1,432	4,088
Sod Waterway (WP-3)	7	22	6	18	5	16	9	-	77	205
Small Grain and Mixed Cover Crop (SL-8B)	37	111	30	91	27	81	43	-	385	1,025
Equine Management										
Small Acreage Grazing System (SL-6AT)	3	-	3	-	3	-	2	-	20	-
Small Scale Manure Composting for Equine Operations – Static Systems (EM-1T)	3	-	2	-	3	-	2	-	18	-
Sewage Systems										
Alternative Waste Treatment System (RB-5)	3	-	9	-	3	-	2	-	25	-
Connection to Public Sewer (RB-2)	10	-	5	-	10	-	1	-	47	-
Septic System Pump-Out (RB-1)	2,153	718	1,142	381	2,389	796	733	-	11,141	3,470
Repair Septic System (RB-3)	324	108	129	43	287	96	59	-	1,577	506
Septic System Installation/Replacement (RB-4)	7	3	6	3	7	3	3	-	40	15
Pet Waste Management										
Pet Waste Disposal Station (PW-1)	28	9	9	3	14	5	2	1	113	40

Control Measure	Phase I Units	Phase II Units	Phase I Units	Phase II Units	Phase I Units	Phase II Units	Phase I Units	Phase II Units	Total Phase I Units	Total Phase II Units
	Po River		**Polecat Creek**		**Poni River**		**Reedy Creek**		**All IP watersheds**	
Pet Waste Composter, Digester and Fermentation (PW-2)	140	47	20	7	48	16	5	-	362	118
Stormwater BMPs										
Rain Garden	1	3	-	3	6	20	1	-	8	33
Constructed Wetland	30	117	31	63	33	120	20	-	150	406
Wet Pond	6	19	26	52	3	10	17	-	55	99
Riparian Buffer – Grass/Shrub	110	380	105	207	166	600	70	-	786	2,258
Wetland Restoration	30	117	31	63	33	120	20	-	150	406

Note: Education and outreach and technical assistance categories are not included in this table as they are expected to proceed continuously throughout implementation.

As has been discussed above, the recommended BMPs have been selected based on water quality modeling that shows they will be sufficient to achieve the water quality goals of this plan, ultimately allowing for a delisting of the waters within the Mattaponi River watershed that are currently impaired for recreational use. Table 8-4 shows the water quality outcomes that are projected once Phase I and Phase II BMPs are in-place. There will be significantly reduced levels of exceedance of the 235 cfu/100 mL criterion and 0% exceedance level of the geometric mean standard of 126 cfu/100 mL in each watershed after Phase I. At the end of Phase II, each sub-watershed is projected to have < 10.5% exceedance rate of the maximum assessment criterion, and 0% exceedance of the geometric mean standard. Note that the Reedy Creek IP watershed achieves both water quality criterion with the BMPs recommended for Phase I.

Table 8-4: Exceedance Rate (%) in IP watersheds

TMDL Scenario	**Criterion**	**Chapel Creek**	**Maracossic Creek**	**Matta River**	**Mattaponi River**	**Po River**	**Polecat Creek**	**Poni River**	**Reedy Creek**
Pre-TMDL	Geometric Mean *E Coli* Criterion, Exceedance Rate (GM > 126 cfu/100 mL)	36.7%	66.7%	41.7%	61.7%	26.7%	26.7%	42.0%	36.7%
	Maximum Assessment Criterion, *E. coli* Exceedances (>235 cfu/100 mL)	27.8%	42.8%	26.8%	49.2%	25.0%	14.2%	14.3%	27.9%
IP Phase I	Geometric Mean *E Coli* Criterion, Exceedance Rate (GM > 126 cfu/100 mL)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Maximum Assessment Criterion, *E. coli* Exceedances (>235 cfu/100 mL)	12.0%	19.8%	13.7%	15.5%	13.0%	12.5%	12.9%	10.0%
IP Phase II (TMDL)	Geometric Mean *E Coli* Criterion, Exceedance Rate (GM > 126 cfu/100 mL)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Maximum Assessment Criterion, *E. coli* Exceedances (>235 cfu/100 mL)	10.1%	10.5%	10.0%	10.0%	10.5%	9.9%	10.4%	10.0%

To best ensure ultimate success, the recommended management measures should be reevaluated toward the end of Phase I, in light of water quality monitoring results. Based on this reevaluation, Phase II BMPs may be altered or not implemented depending on the water quality improvements achieved through the implementation of Phase I measures.

8.1 Prioritizing Agricultural Actions

In the 2016 Mattaponi Watershed Bacteria TMDL report, pasture lands were shown to contribute the greatest existing bacteria loads in all 14 TMDL watersheds. Accordingly, to achieve water quality standards, the greatest bacteria reductions need to come from this source. Agricultural conservation measures that prevent cattle access to streams through exclusion fencing, while providing alternative sources of water, and create a riparian buffer area that reduces bacteria runoff from pastures into area streams are essential to improving water quality to meet the State's standards discussed above.

Since livestock exclusion fencing eliminates 100 percent of direct deposits of bacteria into streams from cattle (see Table 5-2), while the buffer zone further reduces (by approximately 50%) bacteria reaching the streams in pasture runoff, this is the top priority management measure during plan implementation. As discussed in Section 3.5, exceedances of the bacteria standard have occurred during low flow conditions, which may indicate direct deposition sources of contamination, in the Maracossic Creek (including Beverly Run), and the Mat, Matta, Po, and Poni River TMDL watersheds. Also, Chapel Creek, which had no low flow monitoring events, is included in this watershed grouping believed to have direct deposition sources of bacteria. These watersheds are the highest priority for identifying additional livestock exclusion fencing needs.

The exclusion fencing needs recommended for each watershed were estimated through data analysis described in Section 3.4.4. During the IP development meetings, agricultural stakeholders questioned the extent of LEF fencing needed, given the relatively low livestock populations within the very large IP project area. To aid efforts to work through this concern, DEQ provided local SWCD staff large-scale aerial photo maps of the IP watersheds, and local staff began to identify specific locations where known livestock operations were believed to have access to streams. Supported by the recommended technical assistance resources, this type of on-the-ground assessment should be completed to focus outreach with individual producers in a way that will best assure BMP cost-share assistance achieves the greatest near-term bacteria reductions and water quality improvements.

Given that the greatest single source of bacteria in the IP watershed is pasture lands (see Table 3-20), it will also be essential to give high priority to pasture improvements. This plan recommends a suite of pasture management practices for implementation, and notes that the specific practices are "interchangeable", as they all have estimated bacteria reduction efficiencies of 50 percent. Outreach to encourage implementation of whatever form of pasture management is of greatest interest to individual agricultural producers should be given a high priority in the early years of implementation.

Creation of a riparian buffer through use of stream exclusion fencing between livestock grazing areas and local streams is a critical element of reducing bacteria reaching streams from pasture lands. DEQ worked with the local SWCDs during development of this plan to begin identifying specific locations of larger cattle farms that would be important opportunities for additional exclusion fencing. This work was aided with large scale (small area) aerial photo imagery maps shared with the Districts. The SWCDs are encouraged to continue these efforts and expand them to identify smaller livestock farms that do not have fencing in place and conduct outreach to encourage participation in agricultural cost share programs for stream exclusion fencing.

During Phase I, the top priority is to remove livestock from streams and rivers and create additional riparian buffers along streams with adjacent pasture land. Nearly 85 percent of total livestock exclusion fencing required is included in Phase I (which is 10 years in duration). Many of the recommended exclusion fencing practices also include Pasture Management improvements. The additional separate measures for improved pasture management (SL-10T, SL-11 and Sediment Retention) are much more heavily weighed to the later years, with 75 percent of these measures shown in the final five years (Phase II) of the IP. Similarly, 75 percent of the Cropland measures (SL-1, SL-15A, and WP-3) are placed in Phase II of the plan.

Although measures to reduce equine bacterial loads are shown only in Phase I, there is no reason or expectation that they be implemented "first. The overall number of recommended equine practices is relatively small, and the specific IP watersheds where there may be interest by horse owners to pursue the equine/small farm practices is not known at this time. To ensure these practices would be eligible in all IP watersheds, a small (but variable, based on estimated horse population) number of these BMPs are shown in each watershed, and all are shown in Phase I for simplicity.

8.2 Prioritizing Non-Agricultural Actions

Developed lands were shown to contribute the second greatest existing bacteria loads in 12 of the 14 TMDL watersheds (and are the third greatest source of bacteria in the other two TMDL watersheds) in the 2016 Mattaponi Watershed Bacteria TMDL report. So effectively addressing pet waste sources of bacteria, and better managing stormwater runoff from developed lands is a high priority. The Matta, Po, Polecat and Poni TMDL watersheds, through which Interstate 95 passes, and the Mattaponi and Reedy Creek TMDL watersheds have the greatest amount of moderate/high density development that should be prioritized for "urban" BMPs. Giving priority to carrying out some targeted pet waste and developed land stormwater BMPs in the early years of plan implementation is recommended to raise awareness and stimulate increased interest and support for their implementation by area residents.

New funding assistance for residential septic systems may result in the greatest bacteria reduction benefits if it is targeted to older homes located in areas with soils that are poorly suited for drainage. Especially when these homes are occupied by low-income residents, needed septic system maintenance, repair or replacement may be deferred to the point of contributing to water quality impairments. It is recommended that the IP area counties, the Virginia Department of Health, and the three local Soil and Water Conservation Districts (Tri County-City, Hanover-Caroline, and Three Rivers), and the project area counties and regional commissions collaborate to conduct analysis of high priority areas for septic system education and outreach to help target future residential septic cost-share assistance to the areas of greatest need. The analysis prepared by Kevin Byrnes, which documents septic system (or home) age and soil types for the entire IP area, can be highly valuable in focusing such outreach activities. Also, the 2016 TMDL report indicates that the greatest (relative) septic system contributions to water quality impairments are in the Glady Run and Reedy Creek TMDL watersheds, while the Mat, Matta, Po and Poni River, and Polecat Creek TMDL watersheds show residential septic systems to be a greater relative source of bacteria than the other seven TMDL watersheds. All of this information should be used to identify geographic target areas within this very large IP project area for residential septic program outreach and financial assistance.

9 Water Quality Monitoring

As shown in Figure 9-1 below, water quality monitoring has an essential role in the continuous planning process used by DEQ for water quality management. Monitoring conditions relative to the applicable water quality standards allows DEQ to determine which waters are in "attainment" and which are "impaired." The 2016 TMDL report identified the level of bacteria reductions needed to restore the quality of impaired waters, and this TMDL Implementation Plan identifies specific actions recommended to restore water quality to again achieve standards. Future monitoring will be needed to gauge the water quality effects of the BMPs that are implemented, and ultimately determine whether water quality standards are (re) attained.

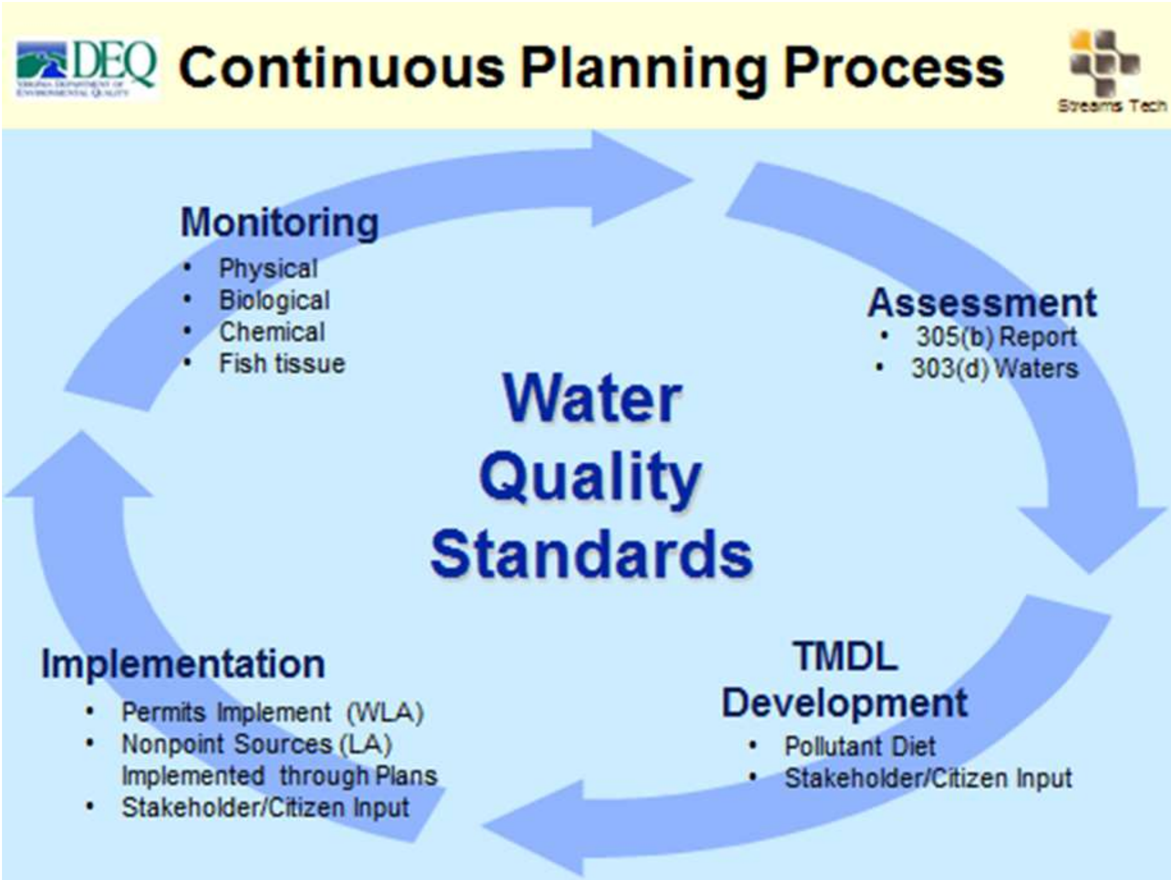


Figure 9-1: Continuous Water Quality Planning Process

When DEQ's monitoring is considered together with others' monitoring activities within the Mattaponi IP watershed, a much more complete understanding of the area's water quality will emerge over time. Proposed monitoring includes 1) continued DEQ monitoring, 2) citizen monitoring, and 3) additional monitoring. Each of these is discussed in more detail below.

9.1 DEQ Monitoring

DEQ regularly conducts monitoring in the IP area as part of its overall water quality monitoring program for the Commonwealth. DEQ's monitoring program both facilitates evaluation of trends over time and allows updated assessments of progress towards achieving the water quality standard. DEQ monitors water quality conditions at seven "Trends" monitoring stations within the IP project area on a regular (bi-monthly) basis annually.   In addition, on a five-year cycle DEQ samples other sites as a part of its probabilistic monitoring program. Other DEQ monitoring occurs periodically to meet specific program needs. "Implementation Monitoring" (IM) is done selectively in areas where BMPs have been implemented to determine the water quality response to actions taken and provide data to support updated water quality assessment decisions. DEQ will work with local stakeholders to identify IM monitoring priorities in the future. These monitoring efforts will continue and be adapted as necessary to evaluate progress towards meeting the bacteria water quality criteria. DEQ's current network of monitoring stations within the IP watersheds is shown in Figure 3-11.

9.2 Citizen Monitoring

Citizen water quality data can greatly improve the understanding of water quality conditions over time. Two communities within the IP project area, Lake Caroline and Fawn Lake, have well established water quality monitoring programs. Both of these citizens' monitoring groups send their samples to labs for analysis, which along with careful collection and handling Quality Assurance/Quality Control (QA/QC) procedures allows DEQ to use the data in its assessment decisions (as it is considered "Level III" data).

Additional citizen monitoring in other parts of the Mattaponi IP watershed would be helpful to supplement DEQ monitoring, and DEQ provides both training and limited financial assistance each year to promote and support citizen monitoring programs. Often citizen voluntary monitoring programs begin with simplified field protocols that do not meet all DEQ QA/QC requirements for use in assessment decisions. "Level I and II" data is useful to enhance overall understanding of water quality conditions and may be used to identify priority areas for additional DEQ monitoring.

In 2016, the Center for Watershed Protection completed a report titled "Safe Waters, Healthy Waters: A Guide for Citizen Groups on Bacteria Monitoring in Local Waterways." (CWP, 2016) This report can serve as a valuable reference both for established citizen monitoring programs, and for those that may be formed in the future.

9.3 Additional Monitoring

Site-specific monitoring efforts may assist in evaluation of management measure effectiveness and add flexibility within an adaptive implementation framework. During the July 24, 2018 Public Meeting in Spotsylvania, a representative of the National Park Service (NPS) described their water quality monitoring activities near the Chancellorsville Battlefield, and indicated it may be possible for NPS to conduct additional monitoring of Lewis Run, which is within the IP project area. At the same meeting, another participant who leads the Central Rappahannock Chapter of the Virginia Master Naturalists indicated some of their members conduct water quality monitoring, and might be interested to consider additional monitoring within the plan area.

Concern and interest to better understand the contribution of wildlife populations to bacteria contamination of Mattaponi watershed streams was expressed at multiple meetings during plan development. Bacteria source tracking using DNA analysis methods was specifically requested, but DEQ does not conduct such analysis at this time due to resource limitations. Given the level of stakeholder interest in this, there may be specific locations within the broad Mattaponi watershed that could be consider for a source tracking pilot in the future. If there prove to be impaired waters where future on-the-ground efforts to locate potential bacteria sources are not fruitful, such areas might be appropriate to consider for a small-scale source tracking project.

During plan development, DEQ learned of past work by students of Randolph-Macon College (R-MC) in Ashland to conduct detailed field analysis of localized water quality problems, providing students with opportunities to address real-world environmental management challenges. A Fall 2019 R-MC seminar class is conducting detailed water quality monitoring and analysis to enhance knowledge of current water quality conditions and sources of contamination in two of the Mattaponi IP watersheds (the Matta and Po River IP watersheds). This work will enhance knowledge of water quality conditions and help to identify areas where BMP implementation may be most valuable.

10 Stakeholder Roles and Responsibilities

Achieving the goals of this plan is dependent on strong participation by many environmental conservation organizations and area landowners and community members. DEQ staff will work with the local SWCDs, counties, and other partners to promote and monitor implementation efforts and evaluate progress. The following sections in this chapter describe the responsibilities and expectations for the various components of implementation.

10.1 Agricultural and Residential Landowners

Since nonpoint sources of runoff to streams is the dominant cause of the bacteria impairment of the Mattaponi River watershed, action by the many local landowners within the watershed is essential to achieving the water quality restoration goals of this plan. While actions are required by many, and the cost of these actions can be significant, government agencies are able to provide both technical and financial assistance to support landowner efforts. Local government, SWCD, and Natural Resources and Conservation Service (NRCS) staff are uniquely positioned to serve as a liaison between individual landowners and the government agencies and programs that can assist them in addressing the sources of bacteria pollution. Their personal knowledge of the local communities, local economy, and natural resources positions them well to foster the collective actions required to achieve this plan's goals.

10.2 Local Soil and Water Conservation Districts (SWCDs) and USDA Natural Resources Conservation Service (NRCS) staff

At the local level in Virginia, SWCDs work in partnership with the U.S. Department of Agriculture (USDA) NRCS staff to deliver agricultural conservation technical advice and services to area producers. There are three SWCDs that have jurisdiction over a portion of the Mattaponi IP project area, The Hanover-Caroline, Three Rivers and Tri-County, City SWCD staff have considerable technical assistance capabilities to offer landowners within the watershed. Together with NRCS, the local SWCDs continually reach out to farmers within their watersheds to provide conservation practice technical expertise. In the absence of this plan, and grant funds that can support its implementation, these Districts would not have the ability to dedicate staff focused solely on the Mattaponi River watershed and this would limit the ability to achieve the ambitious BMP implementation measures called for. With dedicated staffing for the IP watersheds, local SWCDs can provide agricultural BMP design and layout assistance to individual producers. Their staff will more broadly communicate with landowners in the watersheds to help advance environmental education and encourage participation in conservation programs, both agricultural and residential programs that focus on septic systems, pet waste and stormwater management. This IP meets the requirements for funding eligibility under EPA's Section 319 program, for which the three local SWCDs may apply for grant assistance to enable them to target their expertise to Mattaponi River watershed landowners.

10.3 Caroline, King and Queen, and Spotsylvania Counties

Most of the Mattaponi River IP watersheds fall within these three counties, with small amounts also in King William and Orange counties. Decisions made by local government staff and elected officials regarding land use and zoning will play an important role in the implementation of this plan. This makes the local county governments key partners in long term implementation efforts. Much of the IP area falls within the resource protection and management areas of the CBPA. Counties have requirements under the CBPA to notify residential septic system owners of regular (every five years) maintenance requirements. The counties will also serve as key partners in residential stormwater BMP outreach and implementation and may assist with the promotion of pet waste BMPs, including composters and pet waste stations.

10.4 Virginia Department of Environmental Quality

DEQ has a lead role in the development of TMDL implementation plans, which identify the measures recommended for impaired waters to achieve their applicable water quality standards. DEQ also provides grant funding and technical support for TMDL implementation, and will work closely with interested partners on grant proposals for projects included in the implementation plan and track implementation progress.

DEQ will continue to monitor water quality in the Mattaponi River watershed to assess water quality and determine when restoration has been achieved and the streams can be removed from Virginia's list of impaired waters. Every two years, DEQ completes the Virginia Water Quality Assessment 305(b)/303(d) Integrated Report (IR), and future IR reports will document the assessment status of waters in the IP area.

For more information: https://www.deq.virginia.gov/Programs/Water.aspx, accessed 4/12/2019.

10.5 Virginia Department of Conservation and Recreation

DCR works with the state's 47 soil and water conservation districts to help farmers install conservation measures to protect water quality and sustain agricultural productivity. The agency also teaches citizens and businesses lawn care techniques that keep pollution from reaching nearby streams and faraway waterways, such as the Chesapeake Bay. DCR administers the Virginia Agricultural Cost Share (VACS) Program, working closely with the SWCDs to provide cost share and operating grants needed to deliver this program at the local level and track implementation, and the state's Nutrient Management Program, which provides technical assistance to producers for manure storage and manure and commercial fertilizer. DCR helps landowners, land trusts and localities by serving as a clearinghouse and keeping an inventory of protected lands. The agency also identifies important open space and lands rich with plant and animal diversity, and oversees the Commonwealth's Scenic Rivers Program under which a portion of the Mattaponi River has qualified for inclusion (final designation requires legislative action). As well, DCR provides grants and information on conservation easements and other land protection tools. For more information: http://www.dcr.virginia.gov/soil-and-water/, accessed 4/12/2019.

10.6 Virginia Department of Forestry

The Virginia Department of Forestry (DOF) has a 2011 manual to inform and educate forest landowners and the professional forest community on proper BMPs and technical specifications for installation of these practices in forested areas (http://dof.virginia.gov/infopubs/BMP-Technical-Guide_pub.pdf, accessed 5/17/2019). Forestry BMPs are primarily directed to control erosion. For example, streamside forest buffers provide nutrient uptake and soil stabilization, which can benefit water quality by reducing the amounts of nutrients and sediments that enter local streams. Although the DOF's BMP program is intended to be voluntary, it becomes mandatory for any silvicultural operation occurring within state waters (VA Silvicultural Water Quality Law 10.1-1181.2). For more information: visit Chapter 10 in the aforementioned manual. For more information: http://www.dof.virginia.gov/conservation/index.htm, accessed 4/12/2019.

10.7 Virginia Department of Health

The VDH is responsible for adopting and implementing regulations for onsite wastewater treatment and disposal. The Sewage Handling and Disposal Regulations require homeowners to secure permits for handling and disposal of sewage (e.g. repairing a failing septic system or installing a new treatment system). VDH staff provide technical assistance to homeowners with septic system maintenance and installation, and respond to complaints regarding failing septic systems and straight pipes. For more information: http://www.vdh.virginia.gov/environmental-health/onsite-sewage-water-services-updated/, accessed 4/12/2019.

10.8 Virginia Cooperative Extension

The IP area counties have local offices of Virginia Cooperative Extension (VCE). These offices in Bowling Green (Caroline County), King and Queen Courthouse (King and Queen County) and Spotsylvania (Spotsylvania County) connect residents to Virginia's land-grant universities, Virginia Tech and Virginia State University. Through educational programs based on research and developed with input from local stakeholders, VCE offices help improve local communities with programs in Agriculture and Natural Resources, Family and Consumer Sciences, 4-H Youth Development, and Community Viability. For more information: http://ext.vt.edu/, accessed 4/12/2019.

10.9 Upper Mattaponi Tribe

The Upper Mattaponi Tribe owns 32 acres of land within the IP project area, in King William County. The Sharon Indian School, originally built in the early 1900's and replaced with a more modern structure in the 1950's, is the only public Indian school building in the state of Virginia, and now serves as the Tribal Center. The tribe was officially recognized by the Commonwealth of Virginia on March 25, 1983, and received Federal recognition in 2018. In the words of their current chief, "The Mattaponi River has been a life line for my people for centuries. For some years, we the tribes on the river have been trying to restore the spawn of shad and herring with some success but not nearly enough. Clean water is essential to the spawn and the overall health of the Mattaponi fisheries. Also, we would like to see the river stay as pristine as possible for as long as possible because we work, swim and play in these waters." For more information: https://umitribe.org/, accessed 4/30/2019.

10.10 Mattaponi & Pamunkey Rivers Association (MPRA)

MPRA is a broad-based organization dedicated to the protection of the two rivers region's natural resources. MPRA is dedicated to the history, ecology, scenic landscape, recreation, and economy of the Mattaponi and Pamunkey rivers. The Association's goals are to:

- stimulate citizen interest and involvement in resource management issues
- increase awareness of local and regional conservation issues through education
- protect the ecology of the rivers, natural areas, agricultural and forest land, and other area resources
- preserve the historic and scenic qualities of the rivers and surrounding landscapes
- promote responsible recreational use of the rivers
- encourage development compatible with traditional land use patterns and a high quality of life, and
- promote a constructive dialogue between governmental bodies, industry, and citizens.

For more information: https://www.mpra.org/, accessed 4/9/19.

11 Integration with Other Planning Initiatives

11.1 Chesapeake Bay TMDL Watershed Implementation Plan

Significant portions of Chesapeake Bay and its tidal tributaries within Virginia and other Bay States do not meet water quality standards and are listed as impaired. The main pollutants causing these impairments are nitrogen, phosphorus and sediment. Despite significant and sustained efforts for many years, the water quality goals under the Clean Water Act have yet to be met. On December 29, 2010, EPA finalized the Chesapeake Bay TMDL.

The Chesapeake Bay TMDL addresses all segments of the Bay and its tidal tributaries that are on the impaired waters list. The Bay TMDL divided the maximum aggregate watershed pollutant loadings that can achieve the Chesapeake Bay's water quality standards among the Bay states by major tributary basins and source categories (wastewater, urban storm water, septic, agriculture, air deposition). EPA also set a phased implementation planning requirement for all Bay jurisdictions to focus attention on the actions needed to implement required pollutant reductions by 2025.

Virginia submitted its Phase I Watershed Implementation Plan (WIP) in November 2010, and a more refined Phase II plan (WIP II), which was built upon local BMP planning targets, in 2012. Virginia's Phase III WIP was finalized and submitted to EPA on August 23, 2019. Development of Virginia's Phase III WIP involved extensive engagement with the full array of Virginia's Chesapeake Bay watershed local jurisdictions, state agencies, and numerous other partners as well as the public. Virginia DEQ and DCR coordinated local engagement in partnership with the Commonwealth's Planning District Commissions (PDCs) and Soil and Water Conservation District Areas. Implementation of the agricultural, forestry, septic, and urban BMP targets that are identified in Virginia's Phase III WIP, together with ongoing reductions from permitted sources, are sufficient to achieve the Commonwealth's Bay TMDL sediment and nutrient reduction goals.

The Mattaponi River is located in the York River Basin within Virginia's Chesapeake Bay watershed. The pollutant of concern in the Mattaponi River TMDL IP is bacteria. Implementing measures within the Mattaponi River watershed that have been identified in either the local TMDL implementation plan or the Phase III WIP will have the co-benefit of improving local water quality while also supporting efforts to achieve Chesapeake Bay cleanup goals. For bacteria TMDL IPs, implementation of BMPs identified in the Phase III WIP will also provide for protection against excess sediment and nutrients in local waters, even if no local impairment due to these pollutants has been identified. Additionally, stakeholder outreach conducted in the Mattaponi River watershed as part of local TMDL implementation projects can be leveraged to emphasize additional BMP implementation needs identified in the Phase III WIP.

Types and numbers of BMPs identified as part of the Mattaponi River watershed IP are documented in Section 5 of this document. Types and numbers of BMPs identified as part of the Phase III WIP for the York River Basin are documented in Table 3: York River Basin WIP III Final BMPs, of Chapter 8.3 of Virginia's Phase III WIP document. For more information: https://www.deq.virginia.gov/Programs/Water/ChesapeakeBay/ChesapeakeBayTMDL/PhaseIIIWatershedImplementationPlanning.aspx, accessed 10/1/2019.

11.2 County Comprehensive Plans

Local area counties all have comprehensive land use plans that guide development decisions within their jurisdiction in a manner to balance economic development and natural resource management. The Caroline County Comprehensive Plan 2030, adopted by the county Board of Supervisors in 2010 has a

Natural Resources chapter that identifies policies for protection and wise use of forests, agricultural lands, wetlands, floodplains and articulates goals for water quality protection. Similarly, King and Queen County's 2030 Comprehensive Plan (approved in March, 2019) speaks of using "smart growth" approaches to promote economic development and well managed growth. Its Natural Resources chapter calls for considering the "land holding capacity" to evaluate development proposals in light of soils, topography and sensitive environmental settings, such as floodplains and wetlands. Spotsylvania County's Comprehensive Plan, approved in 2013 and updated in 2016 and 2018, calls for directly most new development within the designated Primary Development Boundary, where water and sewer utilities are in place or will be provided. The plan also calls for preservation of forestry and agricultural lands and open spaces and its natural resources appendix discusses the importance of wetlands and watershed protection, while calling for public access to stream corridors and shorelines. Together, these county comprehensive plans serve as an essential foundation for efforts to protect water quality and water resources while planning for continued land and economic development. They can be accessed at the following locations:

Caroline County: https://co.caroline.va.us/267/Comprehensive-Plan, accessed 5/17/2019

King and Queen County: http://www.kingandqueenco.net/, accessed 5/17/2019

Spotsylvania County:
http://www.spotsylvania.va.us/content/20925/20991/24029/24033/24035/default.aspx, accessed 5/17/2019

11.3 Regional Planning and Development Commissions

The Mattaponi IP falls under the jurisdiction of two PDCs. Much of the IP area is within Caroline and Spotsylvania Counties, which both fall within the GWRC, while the portion in King and Queen and King William Counties falls within the Middle Peninsula Planning and Development Commission (MPPDC).

11.3.1 George Washington Regional Commission

In 2011 GWRC issued a plan entitled "Regional Green Infrastructure Plan" that was the result of analysis and deliberations on the benefits of protecting and reestablishing natural and open spaces within the region. It recommended increasing tree canopy to offset losses associated with the region's rapid development, and called for protecting high value conservation core areas, and connecting them via natural area corridors. Its recommendations overlap with those pertaining to improved stormwater management and riparian buffer establishment around streams that are key elements of this IP. For more information: https://www.gwregion.org/wp-content/uploads/2018/01/FINAL-Regional-Green-Infrastructure-Plan-10-20-11.pdf, accessed 5/17/2019.

11.3.2 Middle Peninsula Planning and Development Commission

The MPPDC has a Septic Repair Revolving Loan and Grant Program that provides financial assistance to individuals with malfunctioning, failing, and absent on-site wastewater treatment systems. MPPDC provides a blend of loan and grant funds based on need and funding availability to increase the percentage of homeowners who can repair/replace their failing septic systems with systems that effectively prevent the release of bacteria to local waters and remove additional nitrogen and phosphorus that impair both local waters and the Chesapeake Bay. For more information:
https://www.mppdc.com/index.php/service-centers/wastewater/septic-repair, accessed 6/12/2019

12 Funding for Implementation

A list of potential funding sources available for implementation is listed and discussed below. Detailed descriptions can be obtained from the parent agencies and the websites shown. While funding is currently being provided to the local SWCDs for agricultural BMPs and technical assistance for farmers, additional funding commitments are needed to fully implement the agricultural, residential, and urban practices included in the plan.

12.1 Virginia Nonpoint Source Implementation Program

Virginia's nonpoint source (NPS) implementation program is administered by DEQ through local Soil and Water Conservation Districts (SWCD), local governments, nonprofits, planning district commissions (PDC), and local health departments to improve water quality in the Commonwealth's streams and rivers and in the Chesapeake Bay. DEQ, through its partners, provides cost-share assistance to landowners, homeowners, and agricultural operators as an incentive to voluntarily install nonpoint source (NPS) best management practices (BMPs) in designated watersheds. The program uses funds from a variety of sources, including EPA 319(h) and the state-funded Water Quality Improvement Fund (WQIF) to install BMPs with the goal of ultimately meeting Virginia's NPS pollution water quality objectives. Although resource-based problems affecting water quality can occur on all land uses, the nonpoint source program focuses cost-share assistance on agricultural, residential, and urban lands. The geographic extent of eligible lands is identified in grant agreements and in watershed based plans (WBPs), including IPs approved by DEQ and the United States Environmental Protection Agency (EPA). For more information: https://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/NonpointSourcePollutionManagement.aspx, accessed 4/12/2019.

12.2 Virginia Agricultural Best Management Practices Cost-Share Program

The VACS program is administered by the Virginia Soil and Water Conservation Board and Department of Conservation and Recreation, who allocate annual funding to Virginia's 47 local SWCDs. The program goal is to improve water quality in the state's streams, rivers, and the Chesapeake Bay. VACS offers cost-share assistance as an incentive to carry out construction or implementation of selected Best Management Practices (BMPs). The VACS program encourages the voluntary installation of agricultural BMPs to meet Virginia's nonpoint source pollution reduction water quality objectives. VACS objectives include special emphasis on the reduction of nutrients (nitrogen and phosphorus), and sediment delivered to the Chesapeake Bay; by preventing additional pollution from entering state waters; and meeting the criteria for Virginia's compliance with Section 319 of the Clean Water Act. For more information: http://www.dcr.virginia.gov/soil-and-water/costshar2, accessed 4/12/2019.

12.3 Virginia Agricultural Best Management Practices Tax Credit Program

For all taxable years, any individual or corporation engaged in agricultural production for market, who has in place a soil conservation plan approved by the local SWCD, is allowed a credit against the tax imposed by Section 58.1-320 of the Code of Virginia equaling 25 percent of the first $70,000 expended for agricultural BMPs by the individual. Any practice approved by the local SWCD Board must be completed within the taxable year in which the credit is claimed. The amount of the credit cannot exceed $17,500 or the total amount of the tax imposed by this program (whichever is less) in the year the project was completed. If the amount of the credit exceeds the taxpayer's liability for such taxable year, the excess may be carried over for credit against income taxes in the next five taxable years until the total amount of the tax credit has been taken. This program can be used independently, or in conjunction with other cost-share programs on the landowner's portion of BMP costs. It is also approved for use in supplementing the cost of repairs to streamside fencing. For more information: http://www.dcr.virginia.gov/soil-and-water/costshar, accessed 4/12/2019.

12.4 Virginia Conservation Assistance Program

The Virginia Conservation Assistance Program (VCAP) is a relatively new program that can provide financial incentives and technical and educational assistance to residential/urban landowners who install stormwater BMPs. The program is administered by the SWCDs, who accept and review BMP plans submitted by landowners, verify project eligibility, and issue and track reimbursements for completed projects. All non-agricultural property owners (including businesses and public and private lands) in eligible districts may apply for project funding to reduce erosion, and address poor drainage and poor vegetation that contribute to water quality problems. This A manual has been developed for the program, which includes standards and specifications for BMPs eligible for reimbursement. The local SWCDs may have staff members available to apply for funds through this program in order to work with interested property owners on residential/urban stormwater BMPs. For more information: https://vaswcd.org/vcap, accessed 4/12/2019.

12.5 Virginia Chesapeake Bay Preservation Act Support Grants

In March 2019, DEQ issued a Request for Applications to solicit project proposals by counties, cities, towns, planning district commissions, and soil & waters conservation districts in Tidewater Virginia to support their program activities to satisfy CBPA requirements. Eligible projects for 2019 support included (1) development of programs to conduct conservation assessments for locally designated Chesapeake Bay Preservation Areas; with both the development and review of conservation assessments being eligible for funding, and (2) development of septic tank pumpout programs within CBPA designated areas; notification, education and financial assistance (to low and moderate income homeowners) are eligible activities. For more information: https://www.deq.virginia.gov/Portals/0/DEQ/Water/NonpointSource/ChesapeakeBayActImplementation/DEQ2019CBPA-RFA.pdf, accessed 4/12/2019.

12.6 Virginia Community Development Block Grant Program

"The Virginia Community Development Block Grant (CDBG) program provides funding to eligible units of local government for planning and implementing projects that address critical community development needs, including housing, infrastructure and economic development. The goal of the CDBG Program is to improve the economic and physical environment in Virginia's communities through activities which primarily benefit low- and moderate-income persons, prevent or eliminate slums and blighting conditions or meet urgent needs which threaten the welfare of citizens." For more information: http://www.dhcd.virginia.gov/index.php/business-va-assistance/blighted-structures/community-development-block-grant-cdbg/10-community-development-block-grant-cdbg.html, accessed 4/12/2019.

12.7 Virginia Water Quality Improvement Fund

This is a permanent, non-reverting fund established by the Commonwealth of Virginia in order to assist local stakeholders in reducing point and nonpoint nutrient loads to surface waters. Eligible recipients include local governments, SWCDs, and individuals. Grants for point sources are administered through DEQ and grants for nonpoint sources are administered through DCR. Most WQIF grants provide matching funds on a 50/50 cost-share basis. The Virginia Natural Resources Commitment Fund was established as a subfund of the Water Quality Improvement Fund in 2008. Monies placed in the subfund are solely available for the Virginia Agricultural Cost Share (VACS) Program as well as agricultural needs for targeted TMDL implementation areas, such as the Mattaponi River IP. Watersheds addressed in the water quality improvement plan are eligible for these funds, which are appropriated by DCR to local SWCDs. For more information: https://www.deq.virginia.gov/Programs/Water/CleanWaterFinancingAssistance/WaterQualityImprovementFund.aspx, accessed 4/12/2019.

12.8 Virginia Department of Forestry Logging BMP Cost Share Program

When WQIF Funding is made available, VADOF offers cost-share assistance to timber harvest operators through a unique program offered through the utilization of funding from the Commonwealth's Water Quality Improvement Fund. This program shares the cost of the installation of forestry BMPs on timber harvest sites by harvest contractors. Contractors may receive up to 50% of direct project costs, not to exceed $2,500 per parcel for BMP installation practices involving the stream(s). If the project scope involves the purchase of a portable bridge, assistance shall be 50% of direct project costs plus the portable bridge cost, not to exceed $5,000. For more information: http://www.dof.virginia.gov/costshare/index.htm, accessed 4/12/2019.

12.9 Virginia Riparian Forest Buffer Tax Credit Program

The primary goal of this program is to provide an incentive to landowners through a tax credit for preserving riparian forest buffers along waterways during a timber harvest operation. In 2000, the Virginia General Assembly enacted the Riparian Buffer Tax Credit to provide a non-refundable credit to: Individuals, Family Partnerships, Grantors Trusts, and Limited Liability Corporations. Applicants must own land that abuts a waterway on which timber is harvested. Recipients must refrain from timber harvesting on certain portions of the land for 15 consecutive years. The amount of the credit is equal to 25 percent of the value of the timber retained as a buffer up to a specified limit. The buffer must be at least 35 feet wide and no more than 300 feet and be intact for 15 years. The applicant must have a Stewardship Plan for the tract to qualify. For more information: http://www.dof.virginia.gov/tax/credit/riparianbuffer/index.htm, accessed 4/12/2019.

12.10 Virginia Trees for Clean Water Program

Grants are awarded through this program to encourage local government and citizen involvement in creating and supporting long-term and sustained canopy cover. Through funds from the USFS Chesapeake Watershed Forestry Program, VDOF has developed the Virginia Trees for Clean Water program which is designed to improve water quality in the Chesapeake Bay through on-the-ground efforts to plant trees where they are needed most. Projects include tree planting activities of all types: riparian buffer tree planting, community and neighborhood tree plantings etc. Grant funds will be reimbursed at the conclusion of the project and funding is available on a 50/50 match basis, with in-kind match including volunteer time permissible. For more information: http://dof.virginia.gov/financing/grants.htm, accessed 5//2/2019.

12.11 Environmental Protection Agency Section 319 Grant Project Funds

Through Section 319 of the Federal CWA, Virginia is awarded grant funds to implement NPS programs. DEQ administers the money annually on a competitive grant basis to fund TMDL implementation projects, outreach and educational activities, water quality monitoring, and technical assistance for staff of local sponsor(s) coordinating implementation. CWA Section 319 funding provides for implementation of BMPs in IP watersheds with approved local TMDL IPs. Types and numbers of BMPs identified as part of the Mattaponi River bacteria TMDL IP are documented in Section 5 above. Because the Mattaponi River is located in the Chesapeake Bay watershed, BMPs that are identified in Table 3 of Chapter 8.3 in Virginia's Phase III WIP III document and will result in nutrient and associated sediment reductions both within the local watershed and within Virginia's York River Basin will also be considered for funding under this program. For more information: https://www.epa.gov/nps/319-grant-program-states-and-territories, accessed 4/12/2019.

12.12 EPA/VA Clean Water State Revolving Fund

EPA awards grants to Virginia for its Clean Water Revolving Loan Funds (VCWRLF). The VCWRLF make loans for priority water quality activities throughout the Commonwealth. As recipients make payments, money is available for new loans to be issued to other recipients. Eligible projects include point source, nonpoint source, and estuary protection projects. Point source projects typically include building wastewater treatment facilities, combined sewer overflow and sanitary sewer overflow correction, urban stormwater control, and water quality aspects of landfill projects. Nonpoint source projects include agricultural, silvicultural, rural, and some urban runoff control; on-site wastewater disposal systems (septic tanks); land conservation and riparian buffers; leaking underground storage tank remediation, etc. For more information: http://www.deq.virginia.gov/programs/water/cleanwaterfinancingassistance.aspx, accessed 4/12/2019.

12.13 U.S. Department of Agriculture Conservation Reserve Program

Through this program, cost-share assistance is available to establish cover of trees or herbaceous vegetation on cropland. Offers for the program are ranked, accepted and processed during fixed signup periods that are announced by the USDA Farm Service Agency (FSA). If accepted, contracts are developed for a minimum of 10 and not more than 15 years. Payments are based on a per-acre soil rental rate. To be eligible for consideration, the following criteria must be met: 1) cropland was planted or considered planted in an agricultural commodity for two of the five most recent crop years, and 2) cropland is classified as "highly-erodible" by NRCS. Application evaluation points can be increased if certain tree species, spacing, and seeding mixtures that maximize wildlife habitats are selected. The payment to the participant is up to 50% of the cost for establishing ground cover. Incentive payments for wetlands hydrology restoration equal 25% of the cost of restoration. For more information: https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/, accessed 4/12/2019.

12.14 USDA Conservation Reserve Enhancement Program

This program is an "enhancement" of the existing USDA CRP Continuous Sign-up. It has been "enhanced" by increasing the cost-share rates from 50% to 75% and 100%, increasing the rental rates, and offering a flat rate incentive payment to place a permanent "riparian easement" on the enrolled area. Pasture and cropland (as defined by USDA) adjacent to streams, intermittent streams, seeps, springs, ponds and sinkholes are eligible to be enrolled. Buffers consisting of native, warm-season grasses on cropland, to mixed hardwood trees on pasture, must be established in widths ranging from the minimum of 30% of the floodplain or 35 feet, whichever is greater, to a maximum average of 300 feet. Cost-sharing (75% - 100%) is available to help pay for fencing to exclude livestock from the riparian buffer, watering facilities, hardwood tree planting, filter strip establishment, and wetland restoration. NRCS and the local SWCD determine and design appropriate conservation practices. A 40% incentive payment is offered upon project completion and an average rental rate of $70/acre on stream buffer area is provided for 10-15 years. The State of Virginia will make an additional incentive payment to place a perpetual conservation easement on the enrolled area. For more information: https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-enhancement/index, accessed 4/12/2019.

12.15 USDA Environmental Quality Incentives Program

This program provides a single voluntary conservation program for farmers and landowners to address significant natural resource needs and objectives. EQIP offers one to 10-year contracts to landowners and farmers to provide cost-share assistance, tax credits, and/or incentive payments to implement conservation practices and address the priority concerns statewide or in the priority area. Eligibility is limited to persons who are engaged in livestock or agricultural production. Eligible land includes cropland, pasture, and other agricultural land in priority areas, or land that has an environmental need that matches one of the statewide concerns. For more information: https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/, accessed 4/12/2019.

12.16 USDA Regional Conservation Partnership Program

The USDA Regional Conservation Partnership Program (RCPP) is a five-year program that promotes coordination between NRCS and its partners to deliver conservation assistance to producers and landowners. NRCS provides assistance to producers through partnership agreements and through program contracts or easement agreements. The RCPP competitively awards funds to conservation projects designed by local partners such as SWCDs and nonprofit organizations specifically for their region. Local partners can then work with interested landowners to utilize these funds for BMP implementation. The Chesapeake Bay watershed is one of eight "Critical Conservation Areas" identified in this program. For more information: https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/farmbill/rcpp/, accessed 4/12/2019.

12.17 USDA Agricultural Conservation Easement Program (ACEP)

The Agricultural Conservation Easement Program (ACEP) provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Under the Agricultural Land Easements component, NRCS helps American Indian tribes, state and local governments and non-governmental organizations protect working agricultural lands and limit non-agricultural uses of the land. Under the Wetlands Reserve Easements component, NRCS helps to restore, protect and enhance enrolled wetlands.

For more information: https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/acep/, accessed 4/12/2019.

12.18 USDA Water & Waste Disposal Loan & Grant Program

The Water & Waste Disposal Loan and Grant Program offers funding as either low-interest loans or grants to qualified applicants who are not otherwise able to obtain commercial credit on reasonable terms. Most state and local governments, private nonprofits and federally-recognized tribes are eligible to apply for assistance to aide rural areas and towns with populations of 10,000 or less. Funds may be used to finance the acquisition, construction or improvement of drinking water and wastewater infrastructure; solid waste management; and stormwater collection, transmission and disposal. For more information: https://www.rd.usda.gov/programs-services/water-waste-disposal-loan-grant-program, accessed 5/28/2019.

12.19 USDA Rural Development: Water & Waste Disposal Loan & Grant Program

The USDA Water & Waste Disposal Loan & Grant Program provides funding for drinking water systems, sanitary sewage and solid waste disposal, and storm water drainage to households and businesses in eligible rural areas. It assists qualified applicants who are unable to obtain commercial credit on reasonable terms. Eligible applicants include most state and local governmental entities, private nonprofits, and Federally-recognized tribes in rural areas and towns with populations of 10,000 or less, Tribal lands in rural areas, and Colonias. Funding is provided in long-term, low-interest loans, and partial grant funding is possible based on financial need and funds availability. Relevant to this IP, funds may be used to finance the acquisition, construction or improvement of sewer or storm water collection, transmission, treatment and disposal. For more information: https://www.rd.usda.gov/programs-services/water-waste-disposal-loan-grant-program, accessed 6/12/2019.

12.20 Southeast Rural Community Assistance Project

The mission of the Southeast Rural Community Assistance Project (SER-CAP) project is to promote, cultivate, and encourage the development of water and wastewater facilities to serve low-income residents at affordable costs and to support other development activities that will improve the quality of life in rural areas. They can provide (at no cost): on-site technical assistance and consultation, operation and maintenance/management assistance, training, education, facilitation, volunteers, and financial assistance. Financial assistance includes $1,500 toward repair/replacement/ installation of a septic system and $2,000 toward repair/replacement/installation of an alternative waste treatment system. Funding is only available for families making less than 125 percent of the federal poverty level. For more information: http://sercap.org/services/water-wastewater, accessed 4/12/2019.

12.21 National Fish and Wildlife Foundation

The NFWF administers the Chesapeake Bay Stewardship Fund, which is dedicated to the protection and restoration of the Chesapeake Bay. The Stewardship Fun is supported through partnerships with government agencies and private corporations, and typically awards $8 million to $12 million per year through two competitive grant programs (Innovative Nutrient and Sediment Reduction Grants and Small Watershed Grants) and a technical assistance program. Individual grants generally range between $10,000 and $150,000. A request for proposals is typically issued in the spring and awards are made in the fall. For more information: https://www.nfwf.org/Pages/default.aspx, accessed 4/12/2019.

12.22 Wetland and Stream Mitigation Banking

Mitigation banks are sites where aquatic resources such as wetlands, streams, and streamside buffers are restored, created, enhanced, or in exceptional circumstances, preserved for the express purpose of providing compensatory mitigation in advance of authorized impacts to similar resources. Mitigation banking is a commercial venture that provides compensation for aquatic resources. Mitigation banks are required to be protected in perpetuity, to provide financial assurances, and long-term stewardship. The mitigation banking processes is overseen by the Inter-Agency Review Team (IRT) consisting of state and federal agencies and chaired by DEQ and the Army Corps of Engineers. For more information: https://www.deq.virginia.gov/Programs/Water/WetlandsStreams/Mitigation.aspx, accessed 4/12/2019.

12.23 Additional Sources of Funding

The following programs may be additional potential sources of funding:

- Virginia Outdoors Foundation (VOF). For more information: http://www.virginiaoutdoorsfoundation.org/, accessed 4/12/2019.
- Virginia Nutrient Mitigation Bank Program. For more information: http://www.deq.virginia.gov/Programs/Water/PermittingCompliance/PollutionDischargeElimination/NutrientTrading.aspx/, accessed 4/12/2019.
- U.S. Fish and Wildlife Service (FWS) Conservation Grant Program. For more information: https://www.fws.gov/grants/programs.html, accessed 4/12/2019.

- Trout Unlimited (TU). For more information: https://www.tu.org/conservation/, accessed 4/12/2019.
- Ducks Unlimited. For more information: http://www.ducks.org/, accessed 4/12/2019.

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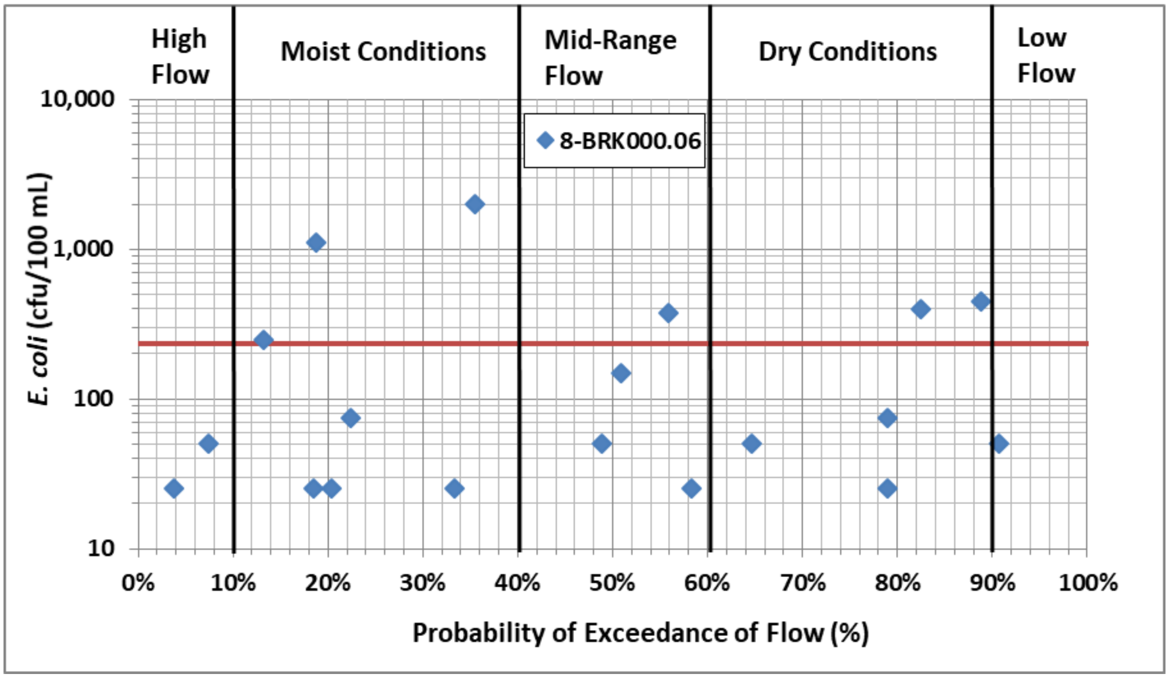
Appendix A: Land use distributions in the Polecat Creek and Reedy Creek TMDL and IP watersheds

Table A-1. Land use distributions in the Polecat Creek and Reedy Creek TMDL watersheds and IP watersheds.

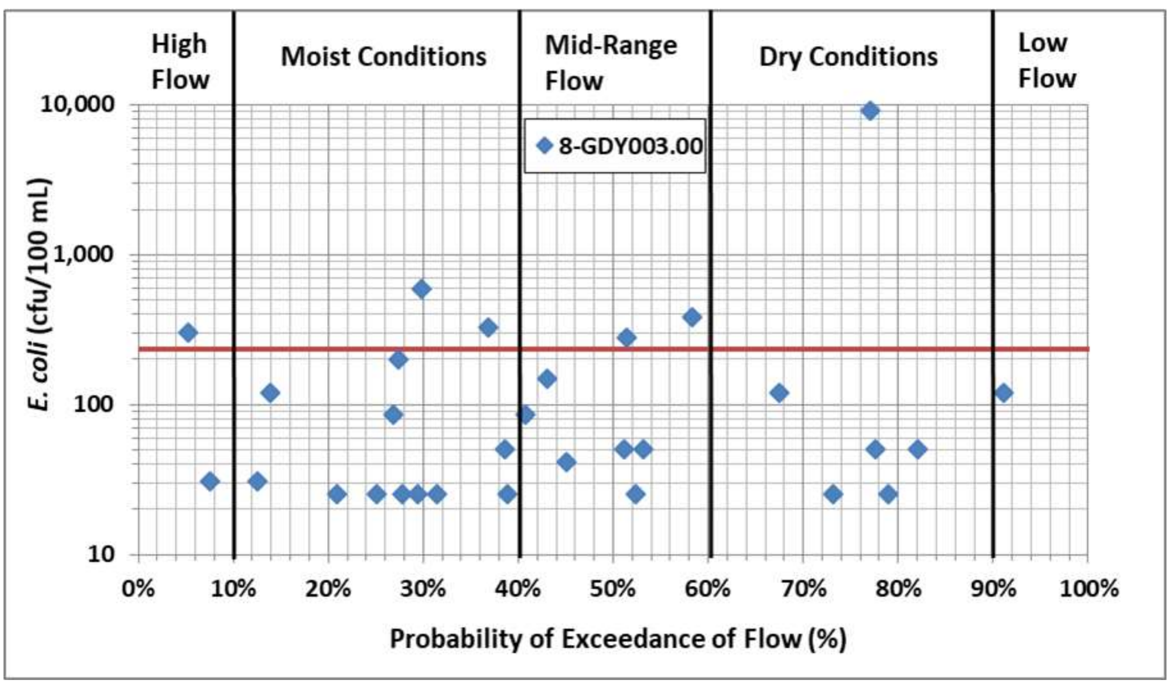
Land Use Description	Polecat Creek				Reedy Creek			
	TMDL Watershed		IP Area		Reedy Creek TMDL Watershed		IP Area	
	Acres	% of Total	Acres	% of Total	Acres	% of Total	Acres	% of Total
Barren Land	0	0.0%	74.2	0.2%	4.2	0.1%	252.2	0.6%
Cropland	194.7	4.4%	2,436.4	7.7%	862.7	11.7%	3,455.5	8.1%
Developed, High Intensity	0	0.0%	35.3	0.1%	0	0.0%	12.4	0.0%
Developed, Low Intensity	20.9	0.5%	599.1	1.9%	4	0.1%	145.5	0.3%
Developed, Medium Intensity	12.2	0.3%	226.1	0.7%	0	0.0%	89.7	0.2%
Developed, Open Space	208.1	4.7%	2,252.5	7.2%	211.7	2.9%	1,750.3	4.1%
Forest	3,255.2	73.5%	20,277.4	64.4%	4,907.3	66.5%	26,927.6	63.1%
Hay*	61.9	1.4%	217.8	0.7%	28.4	0.4%	199.0	0.5%
Pasture	437.9	9.9%	2,336.2	7.4%	935.3	12.7%	3,325.6	7.8%
Water/Wetland	235.4	5.3%	3,031.8	9.6%	425.9	5.8%	6,496.7	15.2%
Total	4,426.4	100.0%	31,486.8	100.0%	7,379.7	100.0%	42,654.5	100.0%

*Hay was separated from the pasture of NLCD 2011 data based on the National Agricultural Statistics Service (NASS 2013) information.

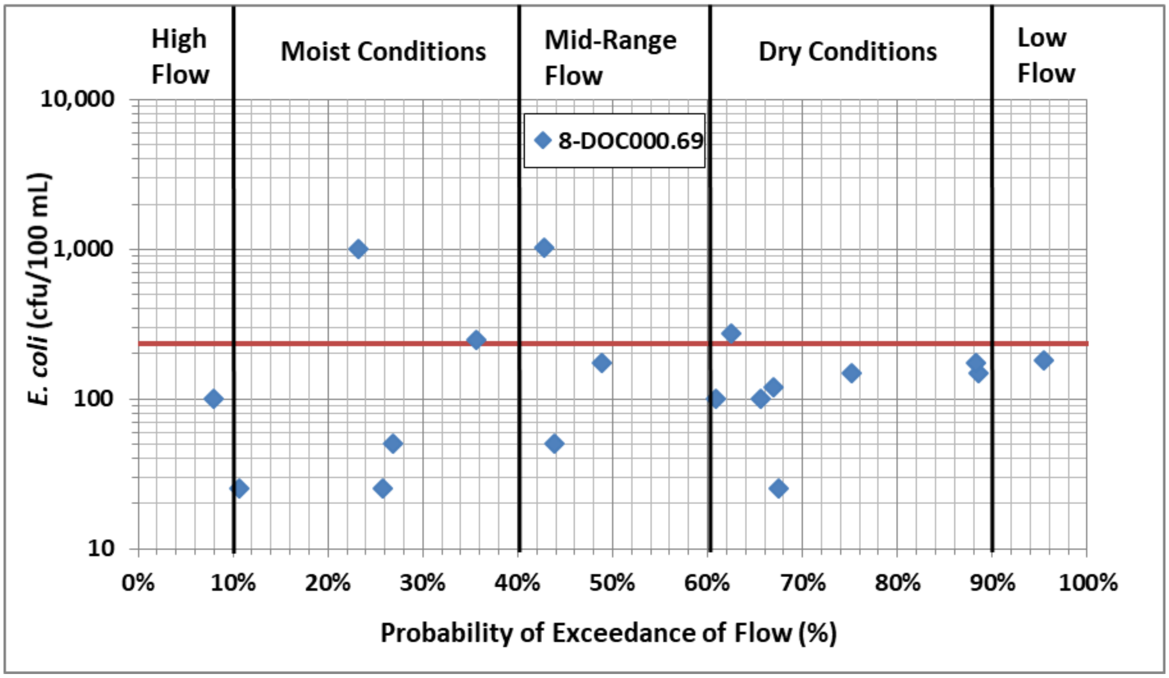
Appendix B: Plots of *E. coli* concentrations versus exceedance probability of flow



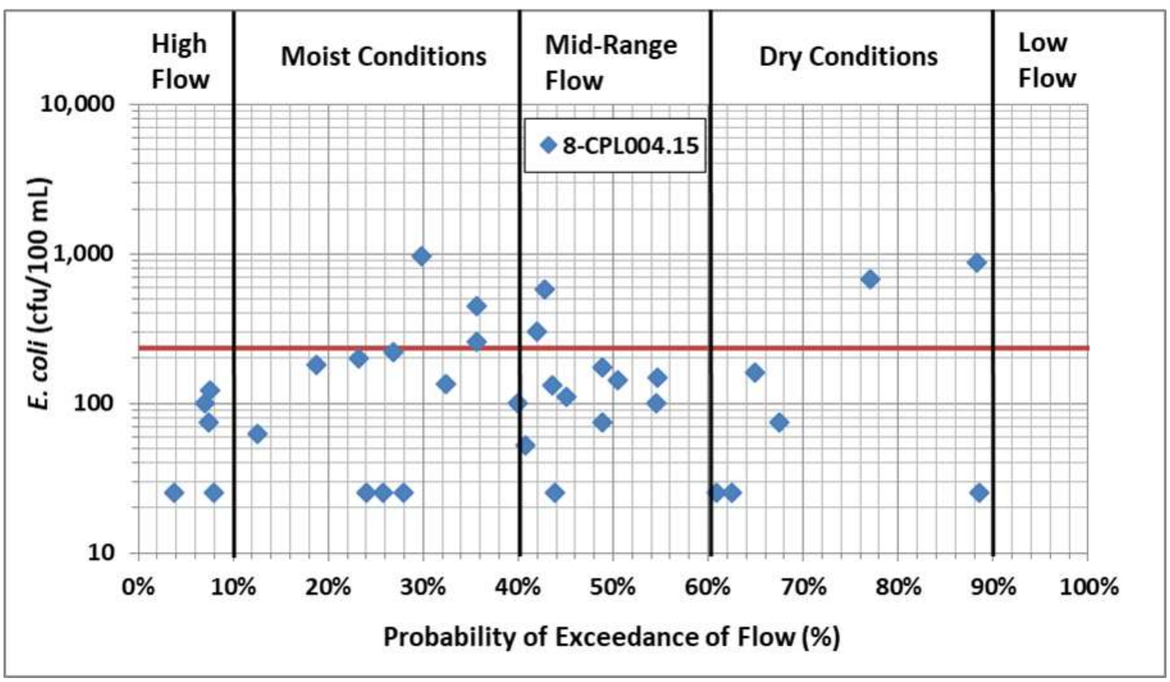
Brock Run (BRK000.06)



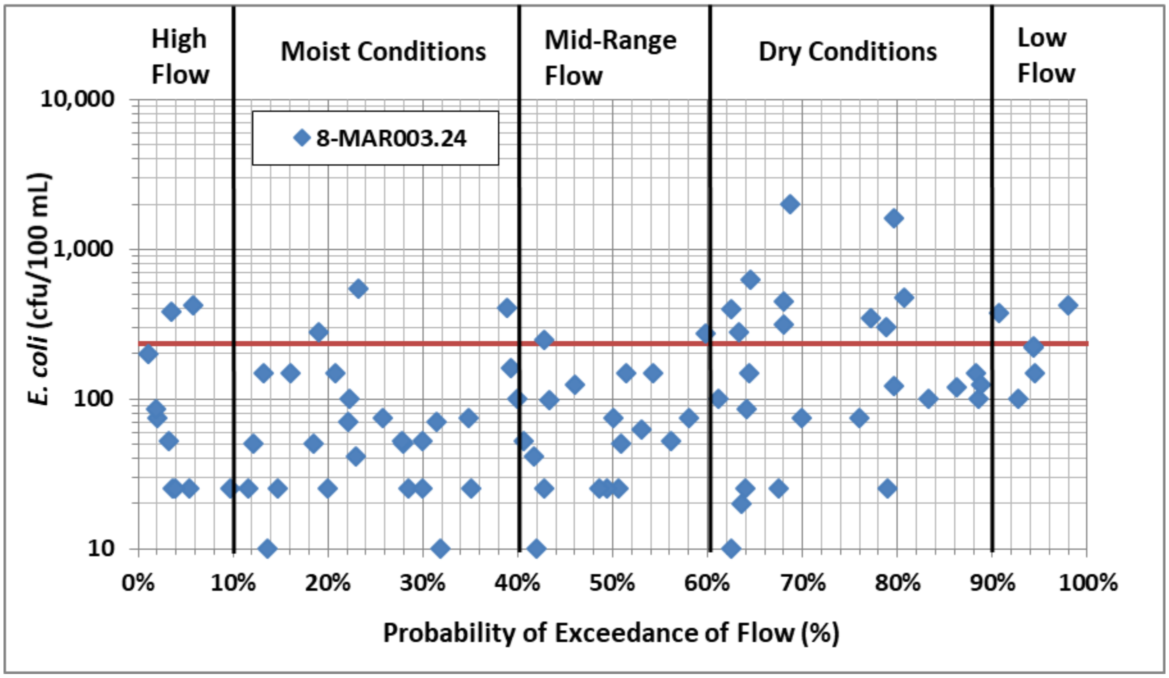
Glady Run (8-GDY003.00)



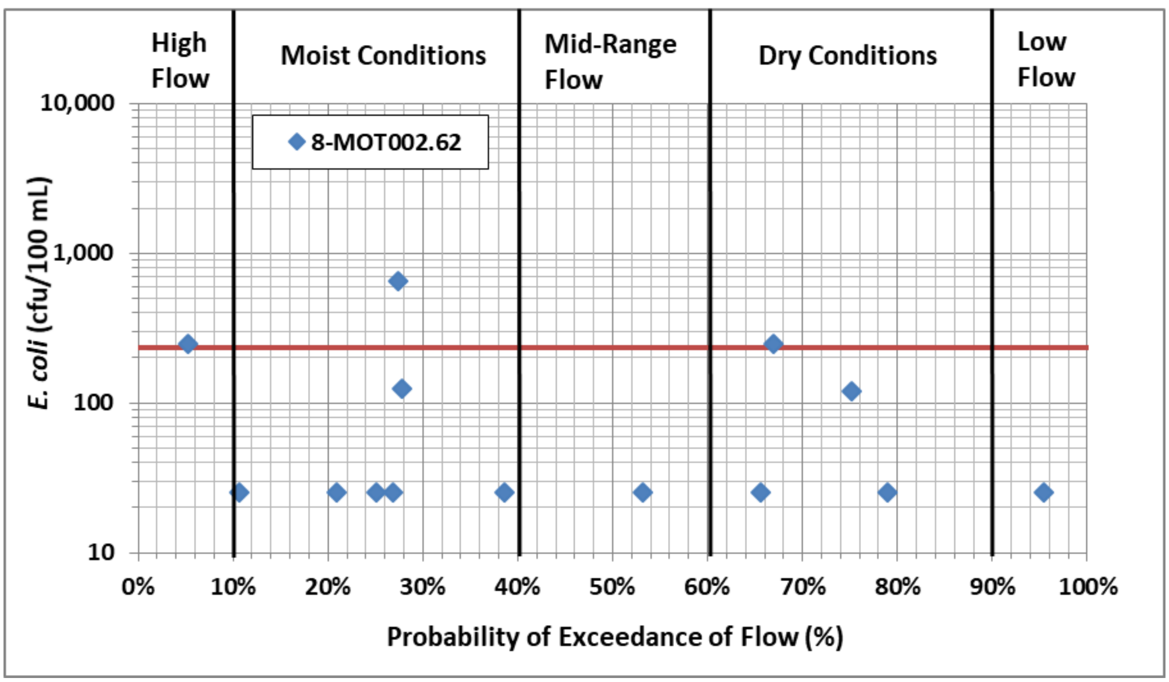
Doctors Creek (8-DOC000.69)



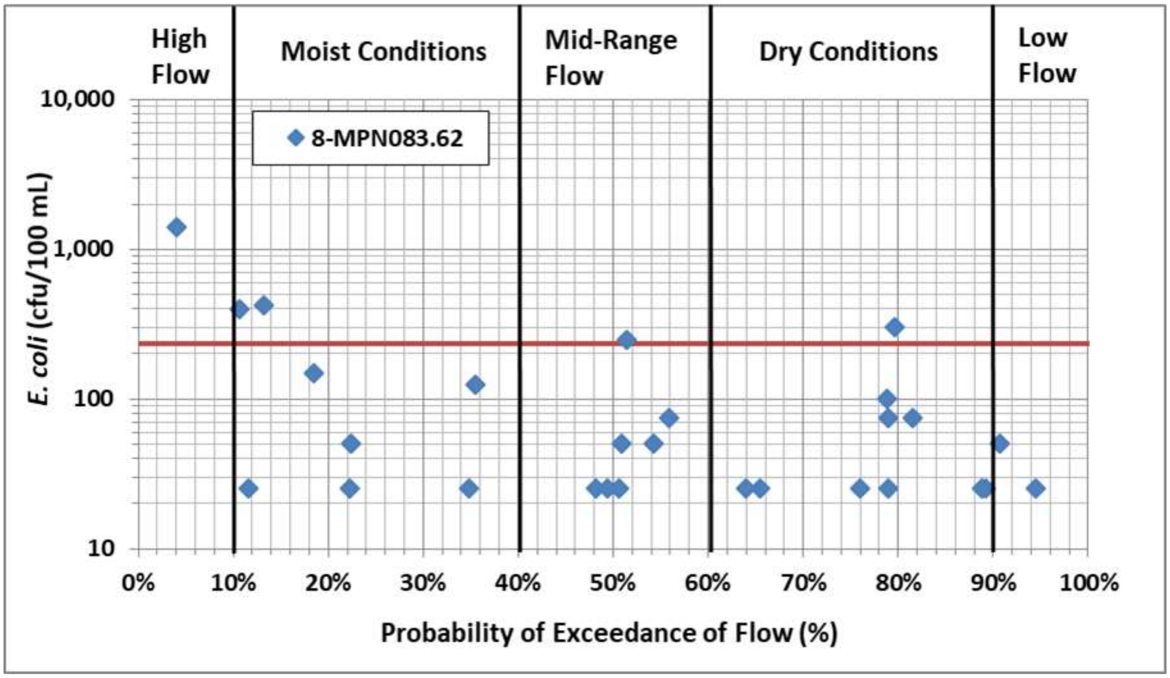
Chapel Creek (8-CPL004.15)



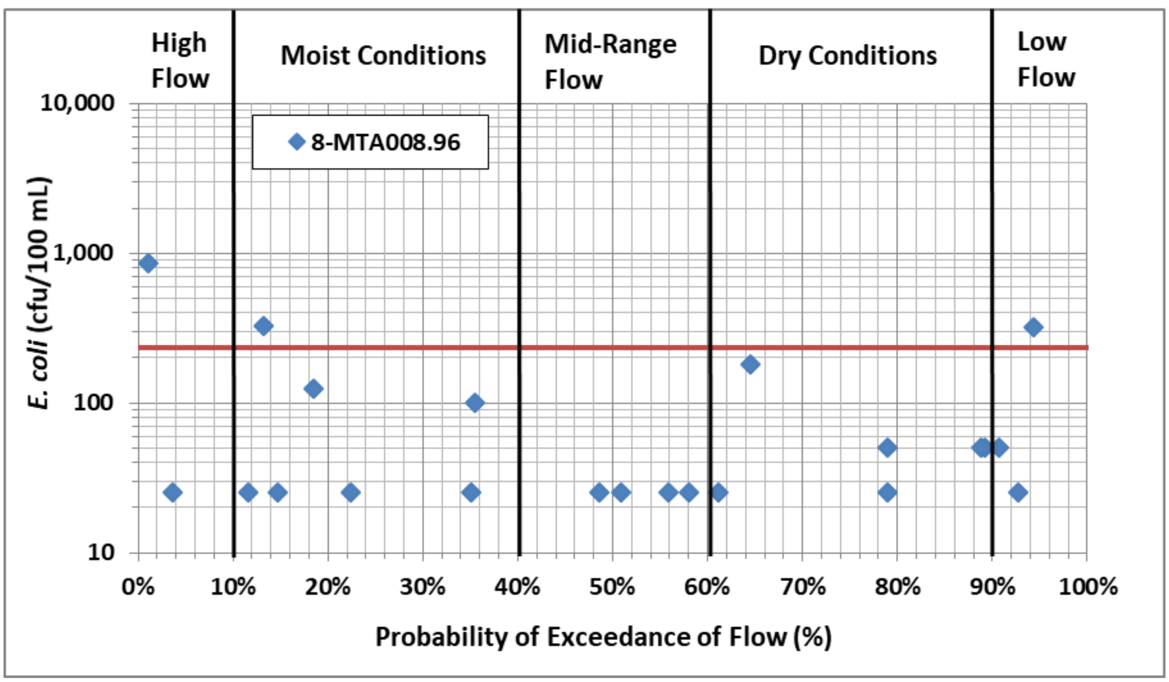
Maracossic Creek (8-MAR003.24)



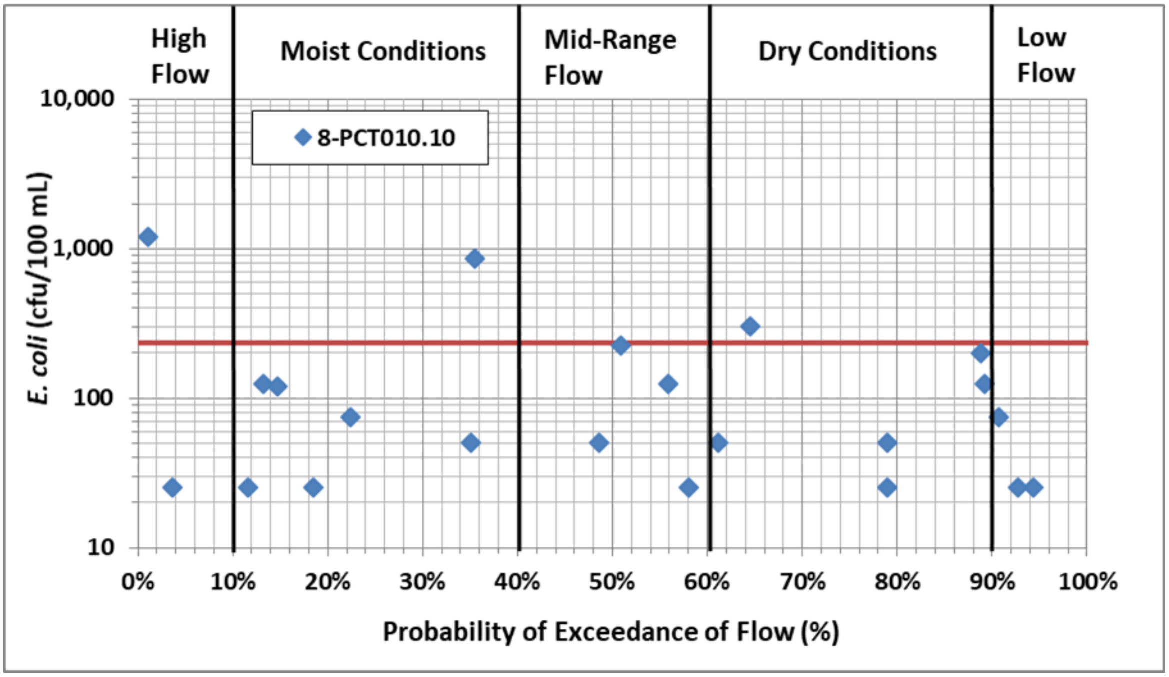
Motto River (8-MOT002.62)



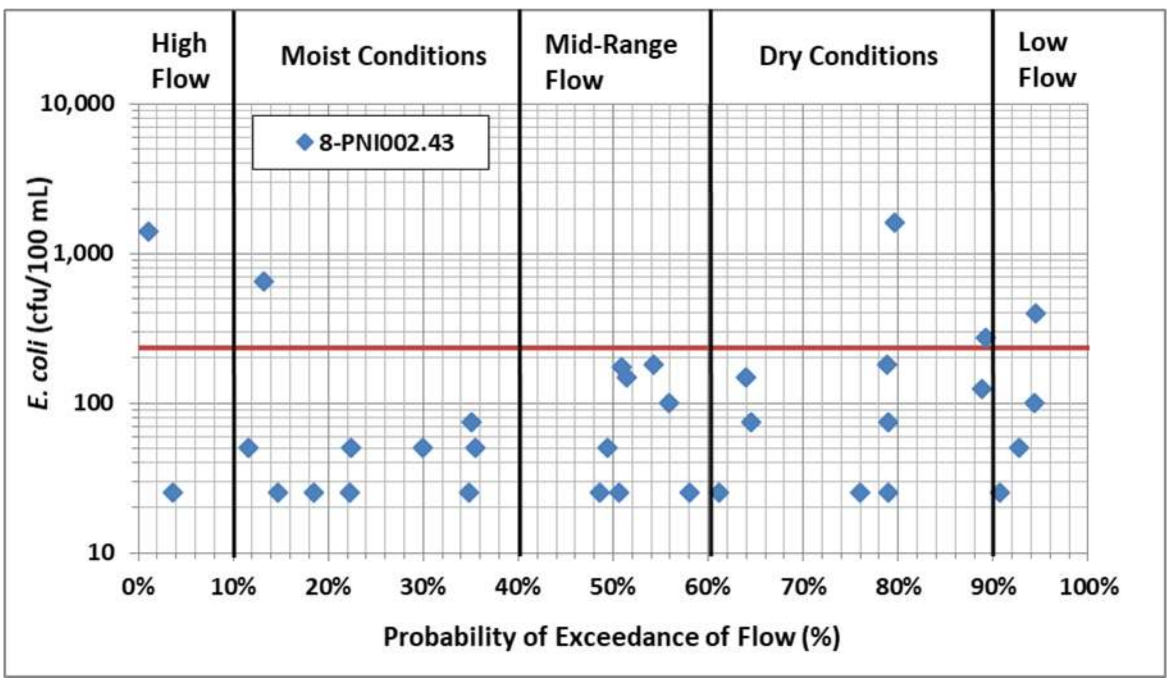
Mattaponi River (8-MPN083.62)



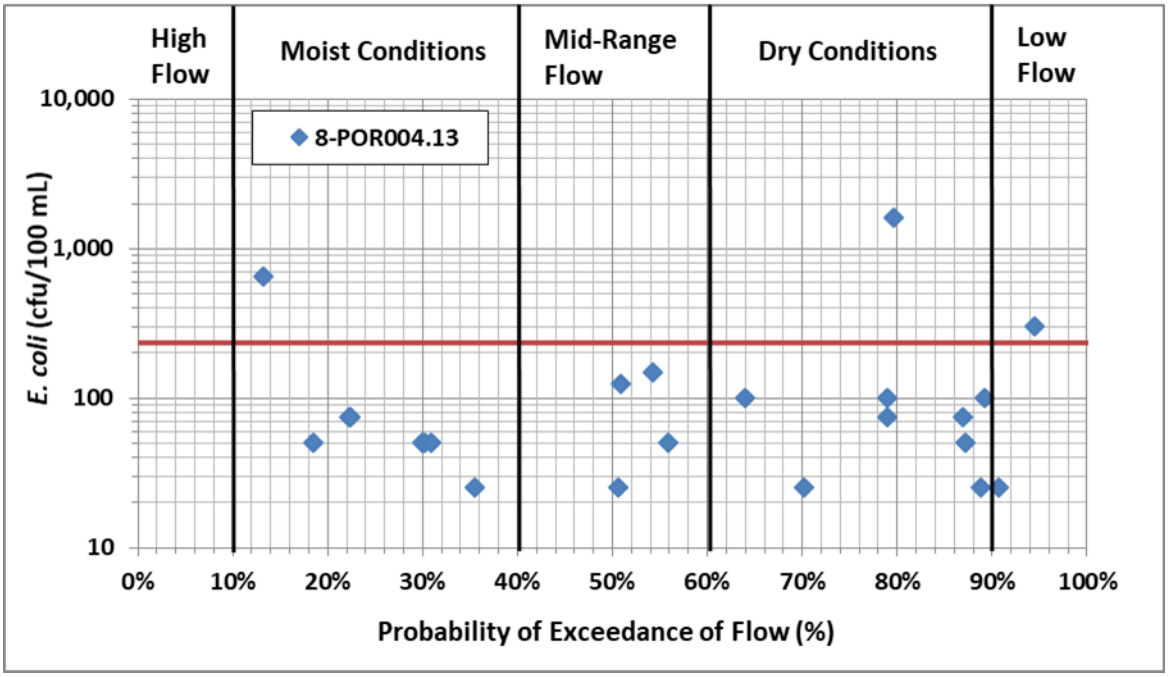
Matta River (8-MTA008.96)



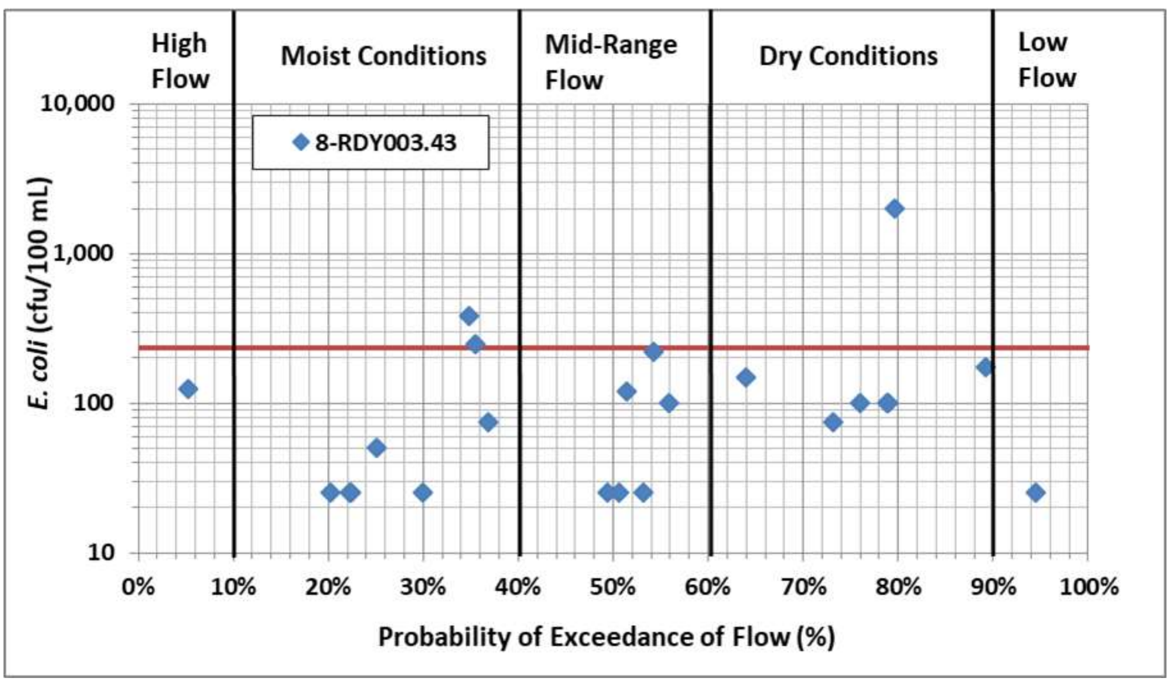
Polecat Creek (8-PCT010.10)



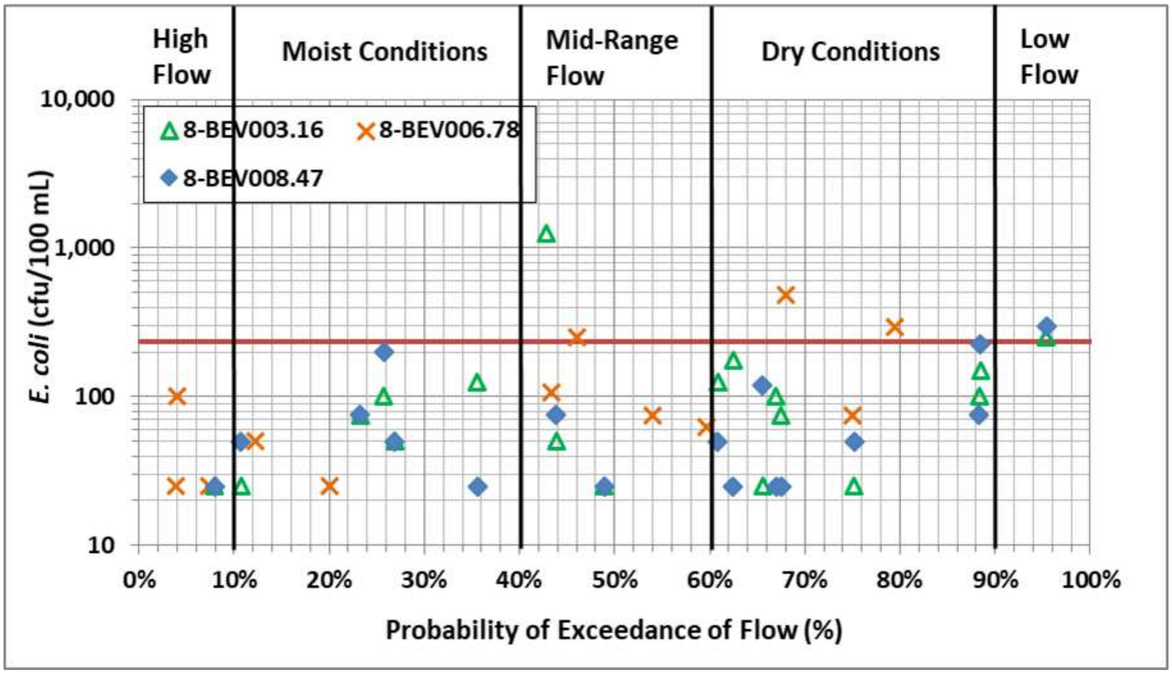
Poni River (8-PNI002.43)



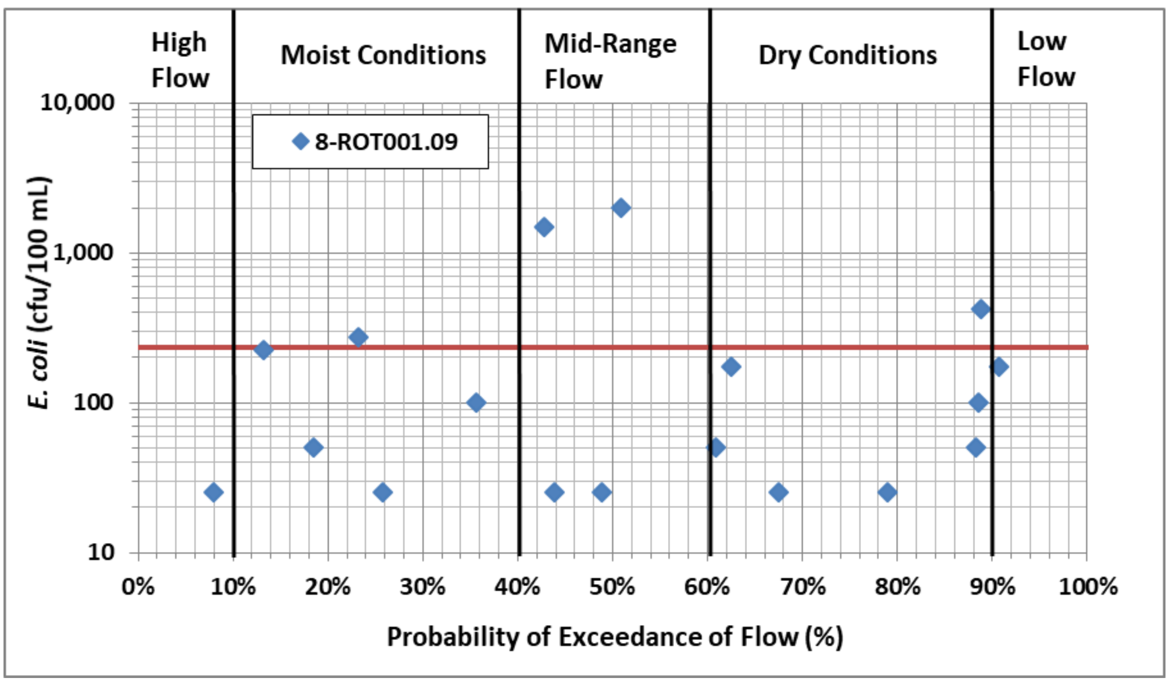
Po River (8-POR004.13)



Reedy Creek (8-RDY003.43)



Beverly Run (Multiple Stations)



Root Swamp (8-ROT001.09)

Appendix C: Revised allocations for Polecat Creek and Reedy Creek TMDLs

C. TMDL ALLOCATION

Total Maximum Daily Load (TMDL) allocation aims to develop the framework to decrease bacteria loads to ensure that water quality standards are met and establish a TMDL equation for each impaired segment. The TMDL, the maximum amount of a pollutant that can be assimilated by a waterbody and still achieve the water quality standard, is the sum of the individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for both nonpoint sources and natural background, and a margin of safety (MOS). This definition is denoted by the following equation:

$$TMDL = \Sigma\ WLAs + \Sigma\ LAs + MOS$$

Development of a TMDL is an iterative process that involves modeling and generation of allocation scenarios that meet the water quality criteria. The calibrated HSPF model was used to develop various pollutant reduction scenarios and the final TMDL allocation. Each scenario consists of a combination of load reductions from direct deposition and/or land based bacteria sources. The modeled scenarios provide an insight to the significance of different bacteria sources in each TMDL watershed and TMDL allocation possibilities. The TMDLs were developed based on the Virginia water quality standard for freshwater primary contact recreational use, which states that the calendar month geometric-mean concentration shall not exceed 126 cfu/100 ml, or that a single sample concentration of *E. coli* shall not exceed 235 cfu/100ml more than 10.5 percent of the time (the maximum assessment criterion). A five-year simulation (2008-2012) of fecal coliform, which was then converted to *E. coli*, provided the necessary data for TMDL calculations.

C.1 Incorporation of Margin of Safety

The margin of safety (MOS) is a required part of a TMDL. The MOS accounts for data limitations and unknown factors related to the relationship between bacteria sources and receiving water quality. The MOS can be incorporated into the TMDL through one of the following processes, in accordance with EPA guidelines (EPA, 1991):

- Implicitly incorporating the MOS using conservative model assumptions to develop allocations
- Explicitly specifying a portion of the TMDL as the MOS and using the remainder for allocations

The MOS was implicitly incorporated in these TMDLs. Conservative assumptions were made in developing the TMDLs that included:

- Selecting a five-year modeling period for the TMDL allocation that included critical hydrologic conditions in the watershed and
- Allocating permitted point sources at the maximum allowable *E. coli* concentrations

C.2 TMDL Allocation Development

The calibrated HSPF model was utilized in developing the TMDL allocations by incrementally reducing bacteria loads from bacteria sources, primarily direct deposition and land-based sources, to meet the water quality standards. Allocation scenarios were developed sequentially, beginning with the headwater impairments and then continuing with downstream impairments until the allocations for all impaired segments were developed. In accordance with the Virginia's *E. coli* criteria, the TMDL allocations ensure that the calendar month geometric mean concentration shall not exceed 126 cfu/100ml and a single sample maximum of *E. coli* shall not exceed 235 cfu/100 ml for more than 10.5 percent of the samples. In order to compare the model results with the criterion, each modeled hourly concentration of bacteria is considered equivalent to a single sample. Therefore, the criterion is met when at least 90 percent of the hourly *E. coli* concentrations during the simulation period is equal to or less than 235 cfu/100 ml.

C.2.1 Wasteload Allocation Development

The design flow of the facilities and a maximum *E. coli* concentration of 126 cfu/100 ml are taken as the basis of the allocated *E. coli* load for VPDES facilities permitted to discharge bacteria. The existing load for domestic sewage discharge general permits is based on the maximum allowable flow rate of 1,000 gallons/day and a maximum *E. coli* concentration of 126 cfu/100 ml. MS4 loads are calculated using the same approach as the calculations of the nonpoint source loads described in the following section, but are considered in the WLA instead of the LA portion of the TMDL equation.

C.2.2 Load Allocation Development

The reduction in loads from nonpoint sources focused on anthropogenic sources, including direct deposition from failed septic systems, straight pipes, and livestock as well as land-based sources from urban and pasture land uses. Although reductions from background sources were not necessary to meet the water quality standards, 100% reduction of direct deposition from wildlife was considered to understand the significance of such background sources. The key load reduction scenarios evaluated for reaching the final TMDL allocations are listed in *Table C-1*.

Table C-1. Load allocation scenarios considered for all TMDL watersheds

Scenario	Percent Reductions to Existing Bacteria Loads				
	Failing Sewage Disposal Systems	**Direct Deposition from Cattle**	**Nonpoint Source: Cropland and Pasture**	**Nonpoint Source: Developed Land uses**	**Direct Deposition from Wildlife**
Baseline	0	0	0	0	0
1	100	0	0	0	0
2	100	100	0	0	0
3	100	100	0	0	100
4	100	50	50	0	0
5	100	100	*	*	0

* Reductions of nonpoint source loads from pasture land and urban land uses vary. The allocation section for each impaired segment discusses the necessary reductions.

C.2.3 Consideration of Seasonal Variations and Critical Conditions

TMDLs need to take into account the seasonal variations and critical conditions for stream flow, loading, and water quality parameters. Seasonal variations include changes in stream flow and water quality due to hydrologic and climatological patterns. The seasonal variations of rainfall, runoff, and fecal coliform wash-off are explicitly incorporated in the long-term HSPF model developed for these TMDLs, utilizing an hourly time-step. Also, fecal coliform accumulation rates were developed on a monthly basis for pasture and cropland to account for its temporal variability. The consideration of critical conditions intends to guarantee that the water quality of the impaired streams is protected during its most vulnerable times. Critical conditions bear significance mainly because they describe a combination of factors that cause an exceedance of the water quality criteria. The model results from a continuous simulation spanning over a five-year period were selected to ensure that the TMDL allocations would meet the water quality standards under critical conditions. Both low flow and high flow conditions were included in the simulation period covering all the flow regimes.

C.2.5 Consideration of Future Growth

Future growth involves planning for future conditions that may require expansion of existing WWTPs, building new WWTPs, or accounting for anticipated land conversions (e.g. MS4 expansions) in a TMDL watershed. DEQ recommends that if a TMDL watershed has no existing permitted dischargers or if the existing WLA in the watershed represents 10 percent or less of the TMDL, the future growth WLA should be 2 percent of the TMDL (DEQ, 2014b). One of these two conditions was applicable to each of the TMDL watersheds and, therefore, the future growth WLA was computed based on the 2 percent rule. The future growth load was then subtracted from LA and added to WLA. Because of the nature of the bacteria TMDLs, any new or expanded permittee may discharge into a TMDL watershed without a TMDL revision.

C.2.6 The Daily Maximum Loads

The EPA (2007) mandated that TMDL studies completed in 2007 and later include a daily maximum load as well as the average annual load. According to the EPA the long-term average *E. coli* loads and coefficient of variations should be determined at the outlet of the impaired segments to implement the final allocation scenarios and express the TMDL on a daily basis. Assuming a log-normal distribution of data and a probability of occurrence of 95 percent, the maximum daily loads should be determined using the following equation:

$$\text{MDL} = \text{LTA} \times \text{Exp}[z\sigma - 0.5\sigma^2]$$

Where,

MDL = maximum daily limit (cfu/day)

LTA = long-term average (cfu/day)

z = z statistic of the probability of occurrence

$\sigma^2 = \ln(CV^2+1)$

CV = coefficient of variation

This formula was utilized in calculating the daily LAs for nonpoint sources from average annual LAs for each impaired segment. Average annual WLAs for point sources were divided by 365 days as a basis for calculating the daily expression of the WLAs. Considering an implicit MOS, the sum of the WLAs and LAs provides the TMDL as the daily maximum values.

A summary of TMDL allocations by sources, WLA, and LA for each impaired segment are represented in the following sections. Each section consists of a set of tables that include a list of modeled scenarios, reductions of *E. coli* loads from individual source categories including their existing and allocated loads, and the TMDL equations on the average annual basis as well as the daily maximum basis.

C.3 Polecat Creek (VAN-F20R_PCT02A02)

The wasteload and load allocation plans and a TMDL summary for the Polecat Creek impaired segment are presented in this section.

C.3.1 Polecat Creek Wasteload Allocation

No individual or general domestic permitted facilities exist in the Polecat Creek TMDL watershed. Therefore, the WLA for *E. coli* (8.64E+11 cfu/year) is the same as the allocation for future growth. Following the DEQ recommendations (DEQ, 2014b) 2 percent of the TMDL was set aside to account for future growth of urban and residential human populations in the Polecat Creek TMDL watershed.

C.3.2 Polecat Creek Load Allocation Plan and TMDL Summary

The scenarios modeled to determine the TMDL allocation for the Polecat Creek TMDL watershed are listed in

Table C. According to the TMDL allocation scenario (number 5), the requirements for meeting the calendar month *E. coli* geometric mean of 126 cfu/100 ml and the maximum assessment criterion of 235 cfu/100 ml for Polecat Creek are:

- 100% reduction of the human sources (failed septic systems and straight pipes)
- 100% reduction of the direct livestock in-stream loading
- 26.5% reduction of bacteria loading from pasture, hay and urban nonpoint sources
- No reduction of bacteria loading from direct deposition from wildlife
- No reductions from the cropland, forested land and wetland

Table C-3 shows the existing and allocated *E. coli* loads and percent reductions for each land use and source in the Polecat Creek TMDL watershed.

Table C-2. Load allocation scenario results for Polecat Creek TMDL watershed

Scenario	Percent Reductions to Existing Bacteria Loads					Percent Exceedance of *E. coli* Criteria	
	Failing Sewage Disposal System	Direct Deposition from Cattle	Nonpoint Source – Cropland and Pasture	Nonpoint Source - Developed Land uses	Direct Deposition from Wildlife	%>126 GM	%>235 cfu/100 ml[1]
1	100					27%	16%
2	100	100				0%	13%
3	100	100			100	0%	13%
4	100	50	50	50	0	0%	6%
5[2]	**100**	**100**	**26.5**	**26.5**	**0**	**0%**	**10%**

[1]The 235 cfu/100 ml criterion allows no more than 10.5% exceedance
[2]Final TMDL Scenario

Table C-3. Annual average *E. coli* load under existing conditions and TMDL allocation for Polecat Creek

Bacterial Source	Annual Average *E. coli* Loads (cfu/year)		Reduction (%)
	Existing Condition	Allocation	
Forest and Wetland	1.47E+12	1.47E+12	0.0%
Urban	5.05E+13	3.75E+13	25.8%
Hay	1.07E+12	7.94E+11	25.8%
Pasture	5.59E+13	4.15E+13	25.8%
Cropland	5.72E+12	4.25E+12	25.8%
Cattle Direct Deposition	5.33E+10	0.00E+00	100.0%
Wildlife Direct Deposition	5.97E+09	5.97E+09	0.0%
Failing Septics	7.76E+10	0	100.0%
Point Source	0	0	
Future Growth		8.64E+11	
Total Loads	**1.15E+14**	**8.64E+13**	**25%**

The TMDL, which is the amount of *E. coli* that the stream can receive in a given year while still meeting the water quality standard, is presented in *Table C-4*. The average annual loads were estimated using a five-year (2008-2012) simulation and taking into consideration the hydrologic and environmental processes involving the fate and transport of bacteria. The WLA reflects an allocation for potential future permits issued for bacteria control. Any issued permit will include bacteria effluent limits in accordance with applicable permit guidance and will ensure that the discharge meets the applicable numeric water quality criteria for bacteria at the end-of-pipe. The Load Allocation is the remaining loading allowed after the MOS and WLA are subtracted from the TMDL as determined at the downstream end of the impaired segment, the watershed outlet. This value may be different from the tables providing nonpoint source load because of factors such as bacteria die-off that occur between the point of deposition and the modeled watershed outlet.

Table C-4. Polecat Creek TMDL (cfu/year) for *E. coli*

WLA	LA	MOS	TMDL
8.64E+11	8.55E+13	IMPLICIT	8.64E+13

The average annual *E. coli* loads were converted to daily loads according to the approach outlined in the *USEPA OWOW 2007 Options for Expressing Daily Loads in TMDLs (EPA, 2007).* The TMDL, expressed in daily loads, is given in *Table C-5*.

Table C-5. Polecat Creek TMDL (cfu/day) for *E. coli*

WLA	LA	MOS	TMDL
2.37E+09	8.78E+11	IMPLICIT	8.81E+11

Figure C-1 and Figure C-2 show the calendar-month geometric mean and daily maximum *E. coli* concentrations under both the existing and the TMDL allocation conditions. The figures also include the geometric mean and the maximum assessment criteria as horizontal solid lines. The figures demonstrate that the developed TMDL ensures that, under the TMDL allocation conditions, both water quality criteria are met in the impaired segment of Polecat Creek.

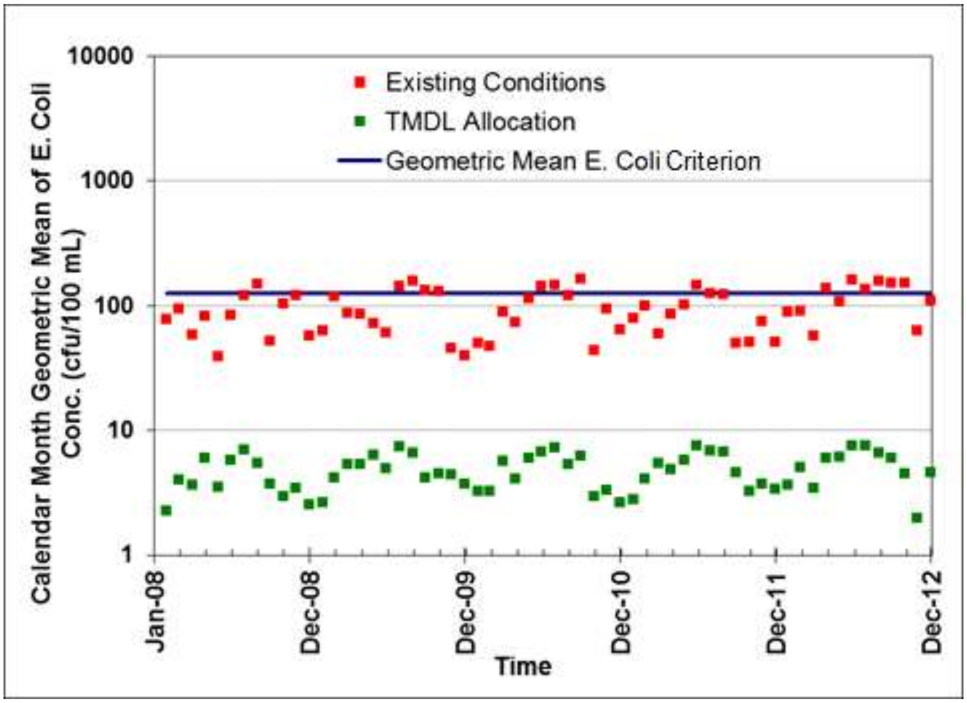


Figure C-1. Polecat Creek monthly GM *E. coli* concentrations under existing and TMDL conditions

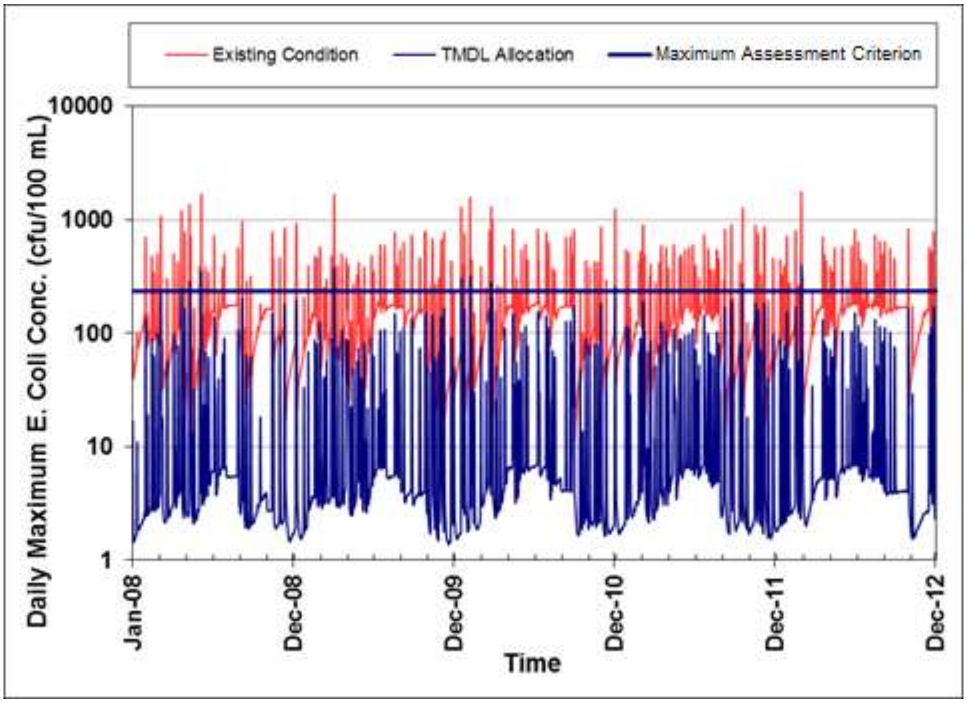


Figure C-2. Polecat Creek daily maximum *E. coli* concentrations under existing and TMDL conditions

C.4 Reedy Creek (VAN-F21R_RDY02A10 and VAN-F21R_RDY02B10)

The wasteload and load allocation plans and a TMDL summary for the Reedy Creek impaired segments are presented in this section.

C.4.1 Reedy Creek Wasteload Allocation

No individual or general domestic permitted facilities exist in the Reedy Creek TMDL watershed. Therefore, the WLA for *E. coli* (6.92E+11 cfu/year) is the same as the allocation for future growth. Following the DEQ recommendations (DEQ, 2014b) 2 percent of the TMDL was set aside to account for future growth of urban and residential human populations in the Reedy Creek TMDL watershed.

C.4.2 Reedy Creek Load Allocation Plan and TMDL Summary

The scenarios modeled to determine the TMDL allocation for the Reedy Creek TMDL watershed are listed in *Table C-6*. According to the TMDL allocation scenario (number 5), the requirements for meeting the calendar month *E. coli* geometric mean of 126 cfu/100 ml and the maximum assessment criterion of 235 cfu/100 ml for Reedy Creek are:

- 100% reduction of the human sources (failed septic systems and straight pipes)
- 100% reduction of the direct livestock in-stream loading
- 17.7% reduction of bacteria loading from pasture, hay and urban nonpoint sources

- No reduction of bacteria loading from direct deposition from wildlife
- No reductions from the cropland, forested land and wetland

Table C-6. Load allocation scenario results for Reedy Creek TMDL watershed

Scenario	Percent Reductions to Existing Bacteria Loads					Percent Exceedance of *E. coli* Criteria	
	Failing Sewage Disposal System	Direct Deposition from Cattle	Nonpoint Source – Cropland and Pasture	Nonpoint Source - Developed Land uses	Direct Deposition from Wildlife	%>126 GM	%>235 cfu/100 ml[1]
1	100					33%	28%
2	100	100				0%	11%
3	100	100			100	0%	11%
4	100	50	50	50	0	0%	6%
5	**100**	**100**	**17.7**	**17.7**	**0**	**0%**	**10%**

[1]The 235 cfu/100 ml criterion allows no more than 10.5% exceedance
[2]Final TMDL Scenario

Error! Not a valid bookmark self-reference. shows the existing and allocated *E. coli* loads and percent reductions for each land use and source in the Reedy Creek TMDL watershed.

Table C-7. Annual average *E. coli* load under existing conditions and TMDL allocation for Reedy Creek

Bacterial Source	Annual Average *E. coli* Loads (cfu/year)		Reduction (%)
	Existing Condition	Allocation	
Forest and Wetland	2.76E+12	2.76E+12	0.0%
Urban	2.38E+13	1.98E+13	16.8%
Hay	8.37E+11	6.96E+11	16.8%
Pasture	4.85E+13	4.03E+13	16.8%
Cropland	5.97E+12	4.96E+12	16.8%
Cattle Direct Deposition	6.50E+10	0.00E+00	100.0%
Wildlife Direct Deposition	9.91E+09	9.91E+09	0.0%
Failing Septics	3.01E+11	0	100.0%
Point Source	0	0	
Future Growth		6.92E+11	
Total Loads	**8.22E+13**	**6.92E+13**	**16%**

The TMDL, which is the amount of *E. coli* that the stream can receive in a given year while still meeting the water quality standard, is presented in *Table C-8*. The average annual loads were estimated using a five-year (2008-2012) simulation and taking into consideration the hydrologic and environmental processes involving the fate and transport of bacteria. The WLA reflects an allocation for potential future permits issued for bacteria control. Any issued permit will include bacteria effluent limits in accordance with applicable permit guidance and will ensure that the discharge meets the applicable numeric water quality criteria for bacteria at the end-of-pipe. The Load Allocation is the remaining loading allowed after the MOS and WLA are subtracted from the TMDL as determined at the downstream end of the impaired segment, the watershed outlet. This value may differ from the tables providing nonpoint source load because of factors such as bacteria die-off between the deposition point and the modeled watershed outlet.

Table C-8. Reedy Creek TMDL (cfu/year) for *E. coli*

WLA	LA	MOS	TMDL
6.92E+11	6.85E+13	IMPLICIT	6.92E+13

The average annual *E. coli* loads were converted to daily loads according to the approach outlined in the *USEPA OWOW 2007 Options for Expressing Daily Loads in TMDLs (EPA, 2007).* The TMDL, expressed in daily loads, is given in *Table C-9*.

Table C-9. Reedy Creek TMDL (cfu/day) for *E. coli*

WLA	LA	MOS	TMDL
1.90E+09	6.86E+11	IMPLICIT	6.87E+11

Figure C-3 and Figure C-4 show the calendar-month geometric mean and daily maximum *E. coli* concentrations under both the existing and the TMDL allocation conditions. The figures also include the geometric mean and the maximum assessment criteria as horizontal solid lines. The figures demonstrate that the developed TMDL ensures that, under the TMDL allocation conditions, both water quality criteria are met in the impaired segments of Reedy Creek.

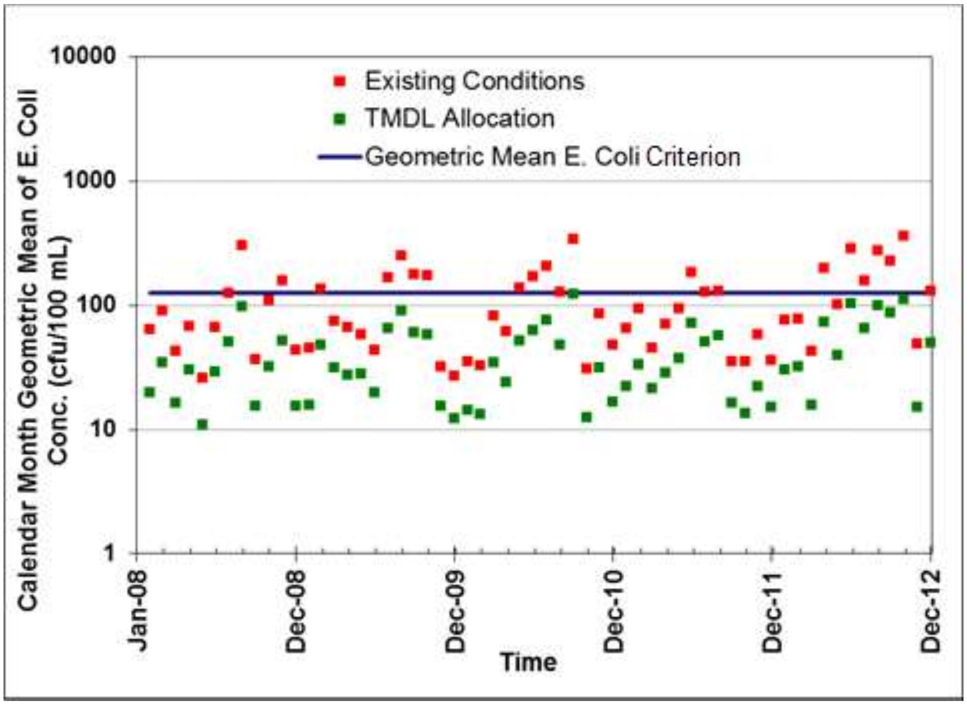


Figure C-3. Reedy Creek monthly GM *E. coli* concentrations under existing and TMDL conditions

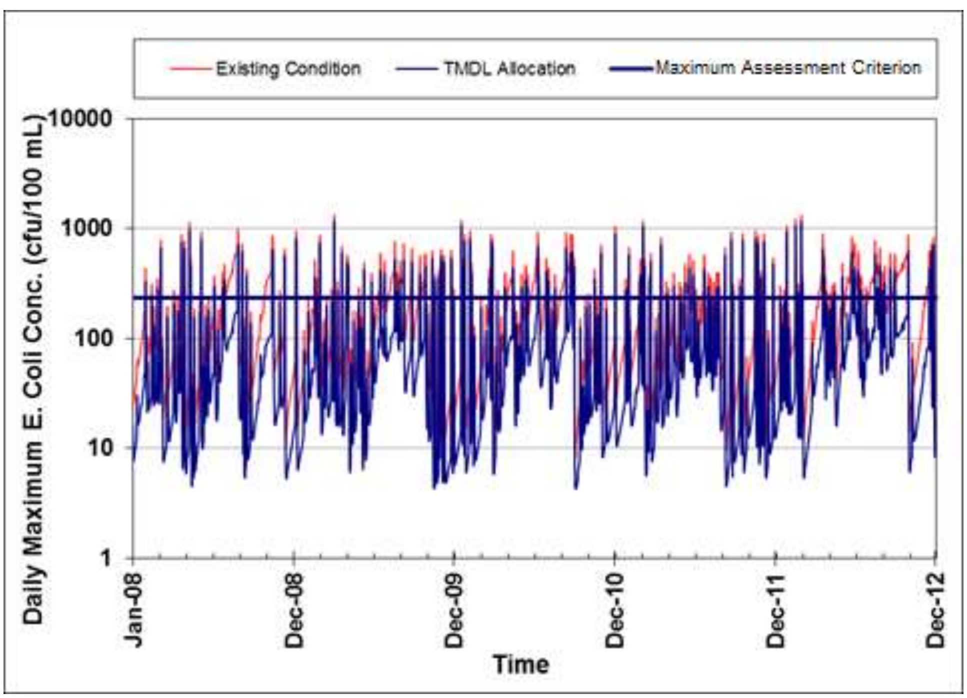


Figure C-4. Reedy Creek daily maximum *E. coli* concentrations under existing and TMDL conditions

Appendix D: Summary of Public Meetings and Workgroup Meetings

D-1: Initial Public Meeting in Spotsylvania Courthouse - July 24, 2018

D-2: Initial Public Meeting in Bowling Green - July 31, 2018

D-3: Agricultural Workgroup Meeting in Milford - November 7, 2018

D-4: Residential Workgroup Meeting in Ruther Glen - January 9, 2019

D-5: Steering Committee Meeting in Bowling Green - March 27, 2019

D-6: Final Public Meeting in Bowling Green - September 10, 2019

D-1: Initial Public Meeting in Spotsylvania Courthouse - July 24, 2018

Mattaponi River Watershed Implementation Plan

Public Meeting #1

July 24, 2018

Meeting Notes

Location: C. Melvin Snow Memorial Library

8740 Courthouse Road

Spotsylvania, Virginia 22053

Start: 6:00 p.m.

End: 7:50 p.m.

Meeting Attendance:

David Evans, VA Department of Environmental Quality (DEQ), Facilitator

Sarah Sivers, VA Department of Environmental Quality (DEQ)

Sayedul Choudhury, Steams Tech, Inc., technical support contractor to DEQ

Richard Street, Spotsylvania County

Brent McCord, Virginia Department of Health

Karen Snape, Virginia Department of Forestry

Nathan Dammeyer, National Park Service

Marta Perry, Tri-County/City Soil and Water Conservation District

Meeting Minutes:

Attendees were welcomed and participants introduced themselves. David Evans of DEQ presented a summary of relevant background and plans for developing a Mattaponi River Watershed Bacteria Total Maximum Daily Load (TMDL) Implementation Plan (IP), using a PowerPoint presentation. This was the first of two initial public meetings for the Mattaponi IP project, the other is to be held in Bowling Green, VA on July 31st. Clarifying questions and brief comments were raised by members during the presentation.

- One was an inquiry of Virginia Department of Game and Inland Fisheries (DGIF) participation in the project, with suggestion they may be able to refine wildlife population estimates; DEQ noted DGIF have been invited to attend, and follow up communications will be made.
- Other questions related to the table of bacteria reduction needs by IP Area and land use/activity. One question was why Cropland is shown to require bacteria reductions, from the perspective that these lands should not present a significant source of bacteria. Related to the same table, there was a request to provide this bacteria reduction information for all 14 TMDL watersheds. A question was asked whether watersheds requiring the greatest reductions were an indication of “something wrong” in the watershed. DEQ observed that it could indicate a significant uncontrolled source(s), but acknowledged that limited water quality monitoring information may also have an effect on modeling results. DEQ will address these questions further in follow up communications with participants.
- Another inquiry pertained to how livestock estimates were prepared, to which Sayedul Choudhury of Streams Tech responded. Agricultural census data was the starting point, and it was adjusted based on area stakeholders input. Concern was expressed that in Spotsylvania County, these figures may not be complete because not all producers responded to inquiries. On completion of the presentation, a group wide discussion ensued. Plans to hold separate breakouts for Agricultural and Residential workgroup discussions were tabled due to the small size of the group. One participant suggested agricultural producers may be more likely to participate if workgroup meetings were held during the winter season.

Key points made during the discussions following the presentation included:

- Public Meeting and Workgroups: a question was asked of the difference between the PM and workgroup meetings. DEQ responded that PMs are more formally noticed and conducted as they satisfy Virginia's Administrative Procedures requirements. Workgroups are less formal, and DEQ uses them to seek technical input and local knowledge from participants to inform plan development.

- Wildlife/DNA Sourcing: The Spotsylvania County participant recommended that DNA sourcing of bacteria be conducted to inform plan development, and shared a perspective that County leaders would likely be reluctant to support implementation of a plan that did not more precisely identify the sources of bacteria within the IP Area watersheds. There was discussion of advancements in the accuracy and reductions in the cost of this type analysis. DEQ noted that while DNA sourcing analysis would not be done in advance of the IP's development, the IP report could recommend this analysis be included in the initial stage of plan implementation, and findings could inform decisions on what measures would be most appropriate to focus on later in the plan's implementation.
- Bacteria behavior and modeling: A participant observed that they understood that scientific understanding of the behavior of bacteria in the environment has evolved. DEQ said they were not familiar with any recent analysis of this nature, but could look into it. The Streams Tech consultant discussed how the TMDL modeling analysis of bacteria and precipitation was conducted. Rainfall data is the most import input to the model that generates runoff and nonpoint source pollution during wet weather events. Since rainfall varies both spatially and temporally, it is important that accurate and local rainfall measurements are used in developing the hydrologic model. The hydrologic model addresses spatial variations by segmenting the watershed into many smaller subwatersheds. Each subwatershed is the smallest unit uniquely characterized by land use distributions, soil characteristics and rainfall-runoff parameters. Applying long-term rainfall time series data to individual subwatersheds and routing the runoff from all the subwatersheds upstream of a streamflow gage allows a comparison of simulated and observed flow data. The model parameters are then adjusted to calibrate the model, which makes the simulated flow better match the observed data. A model calibration using a multiyear observed data gives confidence in the model's ability to predict flow under varying weather conditions. The long-term (e.g. 8 to 10 years) continuous rainfall data in short time intervals (e.g. hourly) were often not available from local sources. Rainfall data obtained from the local sources and major airports were also evaluated during the development of the TMDLs. Finally, precipitation data provided by the National Aeronautics and Space Administration's Tropical

Rainfall Measuring Mission (TRMM) were utilized. TRMM provided local precipitation data in 0.25° x 0.25° cells from 1997 through 2012 at a three hour interval. The TRMM mission ended in April, 2015. GPM, a new mission by NASA, now provides precipitation data in 0.1° x 0.1° cells in 30-minute intervals.

- Sayedul also observed that from his perspective informed by 20 years of impaired watershed analysis, that wildlife alone have not been found to cause impairments. Direct deposition sources can be isolated by analyzing bacteria sampling conducted in dry weather conditions, and more precisely identified through source tracking. A review of wet weather monitoring data will help to identify the sources associated with storm runoff.
- Precipitation variation in project area: Participants discussed the high variation in precipitation amounts across the IP Area, referencing recent storms. Rain gauges in Spotsylvania County measured rainfall amounts ranging from 0.1 to > 6 inches for a July 21, 2018 rainstorm, with the average being approximately 2 inches. Concern was expressed that this variation seemed likely to affect modeling results.
- Bacteria Sources of Concern: In response to DEQ seeking input on what seemed to be important bacteria sources to address in the IP, Richard said that there is only a single sewer line in Spotsylvania (Thornburg), and that septic systems would be important to address. Pet wastes were also noted to be worthy of attention in the plan, as well as livestock operations.
- Planned Solar Power Facility: The Dept. of Forestry representative observed that the biggest recent land use change is associated with a large planned solar power facility in the northwest corner of IP area. 6,000 acres of forest has been cleared for construction of this facility.
- NPS monitoring: The NPS representative observed that their monitoring has found extremely high bacteria levels on Brock Run (Lewis Run?) below the Wilderness Resort development (Fawn Lake), and was surprised this segment isn't identified as impaired. He noted that NPS would be willing to do more sampling adjacent to their Chancellorsville battlefield property. DEQ asked whether NPS might be able to conduct DNA Sourcing analysis, and Nathan said he would be willing to consider/discuss further.
- Indian Acres: Participants noted that the Indian Acres development has a private wastewater treatment facility, and expressed uncertainty as to how adequate it was for treating area wastewater.

- VA Central Rappahannock Master Naturalists/WQ Monitoring: Karen (DOF) noted that she leads the Central Rappahannock Chapter of Master Naturalists, and that their members conduct some water quality monitoring. The Master Naturalists may be able to conduct some targeted monitoring to inform plan development and implementation.
- Residential home aging analysis: There was discussion of how best to identify potential septic system issues, and what is the best information on home age. Aerial photo analysis was noted as the best way to identify the age of older homes, with aerial photography from 1937 and 1962 available.
- Livestock trends – participants noted that there seems to be recent increases in chicken and horse/hobby farms. Also Llamas farms, near (I-95) are a recent change to the area's agricultural sector.
- GWRC Residential Septic Drainfield Analysis: The George Washington Regional Commission is conducting a project to identify existing septic drainfields that fall within the Chesapeake Bay RPA area (100' from stream). Kevin Burns was noted as a good contact at GWRC for this study, and there is an upcoming Aug. 2 meeting planned.
- Stakeholder Outreach: Participants encouraged DEQ to specifically reach out to Amy Walker, Department of Conservation and Recreation, and environmental staff at Fort AP Hill to encourage their participation in the July 31 Bowling Green Meeting. Follow up with the Fawn Lake Homeowners Association was also recommended.

DEQ thanked participants and concluded the meeting at 7:50 pm, after reminding all that Public Comments will be taken on DEQ's plans to prepare the Mattaponi Implementation Plan through August 30, 2018 (to be submitted to David Evans by email at David.Evans@deq.virginia.gov).

D-2: Initial Public Meeting in Bowling Green - July 31, 2018

Mattaponi River Watershed Implementation Plan

Public Meeting #1

July 31, 2018

Meeting Notes

Location: Bowling Green Town Hall
117 Butler Street
Bowling Green, Virginia 22427

Start: 4:30 p.m.

End: 6:30 p.m.

Meeting Attendance:

David Evans, VA Department of Environmental Quality (DEQ), Facilitator

Rebecca Shoemaker, VA DEQ, Northern Regional Office

Ashley Wendt, VA DEQ, Central Office

Sayedul Choudhury, Steams Tech, Inc., technical support contractor to DEQ

Brent McCord, Virginia Department of Health

Matthew Coleman, Virginia Department of Forestry

David Nunnally, Caroline County

David McIntire, King & Queen County

Olivia Mills, Fort A.P. Hill (contractor)

Ashley Hall, Stantec (VA Dept. of Transportation Contractor)

Jim Tate, Hanover-Caroline Soil and Water Conservation District

Joe Stepp III, Hanover-Caroline Soil and Water Conservation District (Board Member)

Cynthia Hammond, Fawn Lake, Spotsylvania, homeowner

Dave Hammond, Fawn Lake, Spotsylvania, homeowner

Pat Vanderland, Homeowner, Lake Caroline

John (Jack) Vanderland, Homeowner, Lake Caroline

Carol Byrd, Agricultural producer, Caroline County

Stuart Lane, Agricultural producer, Caroline and King & Queen Counties

Roger Rinker, Caroline County

Barbara Bach, Caroline County, Horse farm owner

Bruce Sharpe, Homeowner, Lake Caroline

Lynwood Broaddus, Agricultural producer, Caroline County

Edith Curry Broadhead, Caroline County resident/property owner

Art Terry, Caroline County resident/property owner

Ray Scher, Homeowner, Lake Caroline

Meeting Minutes:

Attendees were welcomed and participants introduced themselves. David Evans of DEQ verbally presented a summary of relevant background and plans for developing a Mattaponi River Watershed Bacteria Total Maximum Daily Load (TMDL) Implementation Plan (IP), due to technical problems with the projector. He promised to share a copy of the presentation with everyone attending by email the next morning. This was the second of two initial public meetings for the Mattaponi IP project, the other was held in Spotsylvania Courthouse, VA on July 24th. Clarifying questions and brief comments were raised by members during the presentation.

- A question was raised about the number and location of Wastewater Treatment facilities in the Mattaponi River watershed. DEQ noted that the powerpoint presentation that will be shared identifies 10 such treatment facilities on a map. These facilities are addressed in the Mattaponi River Watershed Bacteria Total Maximum Daily Load (TMDL) report (2016). They are subject to wastewater discharge permits, and therefore are not a prominent component of the IP. DEQ also said these facilities contribute less than 1% (0.5%) of the bacteria releases to the watershed. Additional discussion probed for specifics about how DEQ knows that actual discharge levels are at the level permitted. DEQ said facility owners are required to monitor their discharges and submit discharge monitoring reports to DEQ. A participant expressed concern that false reports could be submitted and the DEQ staff present said they were not able to speak in more detail about the wastewater permit program, but would be happy to follow up on any specific concerns participants may have with DEQ's wastewater program experts.
- There was also discussion of the estimates contained in the TMDL report for failing septic systems and non-treatment of residential wastes. DEQ indicated the TMDL report estimates were the result of housing stock (number and age) analysis, with some refinement from consultation with local experts. The King & Queen County representative noted that they maintain a database and provide information each year on their efforts and results to ensure homeowners comply with septic maintenance requirements associated with the Chesapeake Bay Resource Protection Area

(RPA), and will be glad to share this data. DEQ noted that Virginia Department of Health (VDH) is the State's lead agency for septic system oversight, and that this planning process provides a good opportunity for close coordination with VDH, DEQ and local governments to identify septic system management needs for the area.

- A participant commented, during discussion of Wildlife estimates in the area, that high geese populations are of concern, especially in and around impounded waters, included stormwater basins. There was a question of whether DEQ performs DNA analysis of bacteria samples to identify the specific sources present. DEQ staff noted that bacteria source analysis was done more commonly years ago, but has not been done in recent years after concerns over the cost and accuracy of the previous analytic approaches were identified. Further discussion noted that new DNA analysis techniques are much less costly and considered more accurate; DEQ said they will look into whether it may be possible to include additional bacteria source analysis to inform development of this plan.
- A participant mentioned that a large proposed Solar Power facility in Spotsylvania County is located in the headwaters of the Po River. While acknowledging that this planning process is focused on bacteria contamination, they expressed concern for the likely increase in stormwater runoff as a result of clear cutting extensive areas of forest for the solar facility. There are many streams and wetlands in the solar facility project area where trees are being removed.
- A question was asked why this process does not address more than just *E. coli*, i.e. other types of bacteria and other water quality concerns. DEQ indicated the focus of plan will be on identifying measures that can reduce bacteria to meet levels called for in the TMDLs, to meet recreational use water quality standards. DEQ then noted that many of the measures to reduce bacteria also will reduce other pollutants such as excess nutrients and sediments. There was also mention that increased pH in this watershed could be due to natural causes as the watershed lies in the Coastal Plain.
- Another participant asked if there are health alerts present in the watershed and whether alerts are sent out to the public. DEQ responded that it does not post health alerts on streams that are identified as "impaired" because water quality standards are not met. Rather, these findings are documented in a bi-annual report submitted to the Environmental Protection Agency and made available to the public (the "305(b)/303(d) Water Quality Assessment Integrated Report , found at: https://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityAssessments/2016305b303dIntegratedReport.aspx.
- A question was raised concerning biosolids and how they are used in the watershed and whether they would be addressed through this process. DEQ staff responded that biosolids application data was considered during development of the TMDLs and biosolids were found not to contribute a significant amount of bacteria because they are controlled by permits and not discharged to waters. DEQ staff present acknowledged that they are not experts on the matter, and would be happy to connect meeting participants with DEQ's biosolids staff if there is interest. DEQ staff stated that if a permitting entity is not following their permit, and a public concern is raised, DEQ must investigate the matter.
- Two participants made comments pertaining to wetlands. One asked if DEQ was using WetCAT (Wetland Condition Assessment Tool, developed by the Virginia Institute for Marine Sciences), which allows users to view online GIS-data. DEQ replied this has not been used, and that it would assess whether it may be helpful for plan development. A question was asked whether wetlands restoration could be a part of the Mattaponi watershed implementation plan. DEQ noted that while wetlands restoration is not normally identified as a measure to address bacteria contamination, this planning process will provide an opportunity to consider whether some limited wetlands restoration in specific locations could contribute to bacteria reductions. If so,

there could be a role for wetlands restoration in the IP. Another participant asked to be informed how to access EPA's wetlands maps for the Mattaponi IP area, as well as the TMDL watershed maps. DEQ said they would share information on Mattaponi watershed maps, and how to access mapped wetlands (the U.S. Fish and Wildlife Service's "National Wetlands Inventory").

DEQ reminded everyone that a 30 day public comment period is underway to seek any feedback people may wish to share on the plans for developing the Mattaponi River watershed Bacteria TMDL Implementation Plan. Public Comments will be taken on DEQ's plans through August 30, 2018 (to be submitted to David Evans by email at David.Evans@deq.virginia.gov). The public meeting was concluded at 5:30pm and participants divided themselves by interest into groups that discussed Residential/Developed lands and Agricultural lands.

Residential Workgroup

The following individuals participated in the Residential/Developed land discussion:

Rebecca Shoemaker, VA DEQ, facilitator

Sayedul Choudhury, Steams Tech, Inc.

Brent McCord, Virginia Department of Health

David Nunnally, Caroline County

David McIntire, King & Queen County

Olivia Mills, Fort A.P. Hill (contractor)

Ashley Hall, Stantec (VA Dept. of Transportation contractor)

Art Terry, Caroline County property owner?

Cynthia Hammond, Fawn Lake, Spotsylvania, homeowner

Dave Hammond, Fawn Lake, Spotsylvania, homeowner

Pat Vanderland, Lake Caroline, homeowner

John (Jack) Vanderland, Lake Caroline, homeowner

Bruce Sharpe, Lake Caroline, homeowner

Ray Scher, Lake Caroline, homeowner

- One citizen mentioned that timbering in some areas caused clear cutting and leave behind a significant amount of debris. Concerned citizens were advised to contact the county officials since this problem is not related to bacteria impairment.

- A Fawn Lake resident discussed the 6000-acre solar farm in the headwaters of Po River. Clear cutting for the solar farm may increase runoff, especially the peak flow at downstream locations. Some segments of Po River may be excavated.
- David Nunnally pointed out that as ponds are built to reduce pollution, they attract migratory species. Ducks and geese in and around the ponds are likely to increase bacteria pollution.
- A resident of the Lake Caroline area indicated that Polecat Creek runs through Lake Caroline, which has a storage capacity of 1 billion gallons, and that the drainage area of Lake Caroline was not properly delineated in the map. Sayedul Choudhury agreed to review the drainage area boundary.
- One citizen asked if anyone tracked the maintenance and repair of septic systems. Brent McCord of VDH replied that they collect this data to a limited extent. The addition of alternative systems and requirements to maintain them requires significant staffing resources.
- Caroline Lake and Land Land'Or communities are on individual septic systems. Dawn and other developments are on community systems. In response to a request from the project team, David Nunnally agreed to provide the sewer service area maps in the area.
- The HOA of Lake Caroline has a Master Plan, which a Lake Caroline area representative agreed to share with the project. Lake Caroline homes have increased from 500 in 1999 to 1,200 currently.
- One participant mentioned that Lake Caroline residents walk their dogs along roads and paths, which are located away from the lake. Properties adjacent to the lake left no room for building paths near water. DEQ staff mentioned that pet waste stations could be installed along the paths. The group thought that horses and boat cleaning were not common sources of bacteria in the Mattaponi River watershed.
- Fawn Lake and Lake Caroline citizens' monitoring groups send their samples to labs for analysis. John Vanderland and Dave Hammond are the point of contacts for the Lake Caroline and Fawn Lake monitoring groups, respectively. DEQ staff mentioned that Jeff Beckley of DEQ can help the local citizen's monitoring program.
- DEQ staff indicated that DEQ's Assessment Program assesses ponds for impairments.
- Volunteers interested to participate in the residential workgroup should contact Dave Evans of DEQ.

Agricultural Workgroup

The following individuals participated in the Agricultural lands discussion:

David Evans, VA DEQ, Facilitator

Ashley Wendt, VA DEQ, Central Office

Matthew Coleman, Virginia Department of Forestry

Jim Tate, Hanover-Caroline Soil and Water Conservation District

Joe Stepp III, Hanover-Caroline Soil and Water Conservation District (Board Member)

Carol Byrd, Agricultural landowner, Caroline County

Stuart Lane, Agricultural producer, Caroline and King & Queen Counties

Barbara Bach, Caroline County, Horse farm owner

Lynwood Broaddus, Agricultural producer, Caroline County

Edith Curry Broadhead, Caroline County property owner

- A set of Agricultural workgroup questions were circulated to members of this group, and all were encouraged to look them over and share their perspectives. To get the conversation started, DEQ asked Jim Tate (H-C SWCD) to share a few big-picture perspectives about agriculture in the area. Jim noted there are some large agricultural producers (including participants present) who have incorporated strong conservation practices in their agricultural operations. He noted that the area includes far more row crop agriculture than animal farms. Jim commented that the estimate of 202 Beef Cows in the Maracossic Creek watershed in particular appeared very high, and also the Horse population estimate for Mattaponi River.
- One participant noted that she owns 27 horses on her property on the Mattaponi River, though she had as many as 50 in the past. She noted that the water table is very high along the Mattaponi, which is good for the horses in drought conditions (grass continues to grow well), but in rainy times like this year it is not a good location to keep horses due to muddy lands, humid conditions and heavy bug infestation.
- Another participant lives just outside the IP area, in the Rappahannock River watershed. He did not wish to comment on agriculture in the IP area, but noted general concerns for great increases in the deer and turkey populations in the area.
- One agricultural producer said animal agriculture really is not an issue in this area. She also noted having assisted DEQ to take water quality samples in more remote areas on Reedy Creek some 7-12 years ago. DEQ prepared a water quality report that she will provide for our consideration in IP development. At that time, bacteria levels were not identified as very high, except following heavy rain/runoff events.
- The owner of Reedy Creek Millpond, which only receives water from upstream in the Reedy Creek watershed discussed that the quality of the pond has greatly deteriorated over time. When her husband and she purchased the pond/adjacent land in 2000, the water was clear to the bottom

and Reedy Millpond was classified as a Class III Recreational Reservoir. They had the water tested to ensure it was safe for swimming and drinking and no concerns were identified. The family members commonly swam in the pond and drank well water during this time. They moved away for about five years, and upon returning in 2014 found the pond and water quality conditions much degraded. She noted that neither DEQ nor Caroline County informed them of elevated fecal pollution levels in Reedy Creek or that Reedy Millpond had been reclassified to a Class IV Swamp.

- On March 6, 2016, her husband was diagnosed with a rare brain cancer - Glioblastoma, and died nineteen (19) days after his diagnosis two years after their return. Subsequently two of their children have developed tumors. She said their lifestyle/habits and genetics provide no explanation, and that environmental exposure seems the most likely explanation. The filtered Artesian-well water was tested in late 2016 by two different labs and the water was found to be "Not potable" with high levels of E-Coli and Coliform. A $4,000 water filtration system had to be installed.
- Presently, the water that leaves the dam (a 60' drop) creates a tremendous amount of long-lasting foam. A Virginia Dam Safety official visited the millpond in 2015. According to the owner, the Dam Safety official said the foam was likely from excess nitrogen and phosphorus from upstream agricultural sources. Pond water often has an oily-sheen present; 10-20 five (5) gallon buckets of congealed sludge commonly aggregate at the dam; and several fish kills have occurred following storms/heavy runoff. Blue-green algae growth has turned the entire 40-acre lake bright green for a week or more in late summer for the past four years. The owner believes that agricultural chemical inputs, clear-cutting of land, and channelization of agricultural runoff in the Reedy Creek watershed are likely causes of these degraded conditions. Also, water inflows to the dam have increased which the owner believes is from runoff into Reedy Creek and Reedy Millpond of water pumped from the Mattaponi River to irrigate a farm bordering the property. Increased water in the Millpond has required investment of $260,000 in structural improvements to ensure dam safety.
- Another area producer described his operations, which included 900 acres of cropland. He uses continuous no-till practices, has put 100-150' stream buffers in place for cropland. He also has some 35 cows, and has installed stream exclusion fencing (10-15 years ago) to keep them out of the streams. He noted that before installing the conservation practices he described, the water was very muddy in appearance in his streams, and now it runs clear. In response to earlier comments about agricultural chemicals, he noted that no-till farming requires use of weed suppressants, but that the stream buffers are designed to address the potential for discharge to streams.
- The final producer who spoke has some 1,400 acres in grain production in Caroline and King and Queen Counties. His operations include use of cover crops, no-till agriculture, and he noted the need for chemical use in no-till operations. He uses bio-solids, and said he's learned that it is important to be ready to apply them quickly after delivery as large storage piles can create runoff, and the product can degrade if not used in the near-term. He noted that his bio-solid supply areas all have buffers in place. Finally he said that the relatively low extent of agriculture in the Mattaponi area (< 20% agriculture, >65% forested) should allow for maintaining high quality environmental conditions through use of modern farming practices.
- The DOF representative noted that he had been able to have individual conversations and answer questions from individual participants, and didn't have anything more to add to the agricultural discussion.
- The DEQ/Central Office representative suggested the next Agricultural workgroup meeting should include a presentation on current water quality conditions/findings for the IP area.

- The DEQ facilitator thanked everyone for their participation, and asked what timing would work best for another workgroup meeting in the Fall. The consensus was that mid-October would be a good time to target.
- Volunteers interested to participate in the residential workgroup should contact Dave Evans of DEQ.

D-3: Agricultural Workgroup Meeting in Milford - November 7, 2018

Mattaponi TMDL Implementation Plan: Agricultural Workgroup Meeting

November 7, 2018

The Mattaponi TMDL Implementation Plan (IP) Agricultural Workgroup met on Wednesday, November 7, 2018 from 10:00 am – 12:00 pm at the Caroline County Public Library, Bowling Green Branch, at 17202 Richmond Turnpike, Milford, VA.

Attendance

Fourteen (14) individuals, including three Department of Environmental Quality (DEQ) staff and a member of Streams Tech., Inc. (DEQ's contractual support) participated in the meeting. Participants are listed alphabetically below:

1. Barbara Bach, SH7 Farm
2. Michelle Carter, Three Rivers SWCD
3. Sayedul Choudhury, Streams Tech., Inc.
4. Tyler Dixon, Caroline County
5. David Evans, Dept. of Environmental Quality
6. Priya Gunduboina, Dept. of Environmental Quality
7. Stuart Lane, VA Hemp Commodities
8. Lauren Linville, Dept. of Environmental Quality
9. Etta Lucas, Tri-County City SWCD
10. David Nunnally, Caroline County
11. Leigh Pemberton, Farm Bureau
12. Marta Perry, Tri-County City SWCD
13. Karen Snape, Dept. of Forestry
14. Jim Tate, Hanover-Caroline SWCD

Meeting Summary

The meeting began with participants introducing themselves, followed by a short opening presentation by Dave Evans, DEQ's Nonpoint Coordinator for the Northern Regional Office. The presentation summarized the TMDL IP process, the role of workgroups in plan development, and provided relevant background information on Mattaponi watershed water quality, Agricultural Best Management Practices (BMPs) used to improve water quality, and analysis and consultations already completed to inform BMP needs.

Several questions were included in a handout provided to workgroup members to guide discussions. The specific issues discussed and key points made during the meeting follow:

Livestock Exclusion Fencing Needs: DEQ observed that Stream Exclusion Fencing and associated Pasture Management BMPs are often at the heart of Bacteria TMDL Implementation Plans. Accordingly, DEQ has prepared GIS analysis to inform plan development on potential fencing needs. Using different approaches, a range of potential fencing needs of 104 – 132 miles was identified. In contrast, consultations with local agricultural professionals identified a much smaller fencing need. Discussion points included:

- Horses are usually already fenced in and don't tend to drink from the water.
- There may be interest from smaller "hobby" farms for fencing practices. Not all of these will qualify for Virginia Agricultural BMP Cost Share Program (VACS) and USDA conservation programs which have agricultural income thresholds (> $1,000/annually).
- DEQ noted that new demonstration BMPs for equine manure composting are available (under Section 319 grants) to horse owners who do not qualify for VACS and USDA conservation programs. DEQ committed to share information about the equine BMPs.

BMPs of interest: DEQ asked participants to discuss what agricultural conservation practices were most popular in the local area, as well as practices that might be of interest if barriers to their implementation could be addressed.

1. **Manure Management**: Participants noted that horse and other small/hobby farms have need for improved management of animal manure.

   DEQ explained that two new (demonstration) Equine Manure Composting BMPs are included in the 2019 Nonpoint Source Program Guidelines. These individual farm manure composting bins were of interest to participants, and Hanover-Caroline SWCD noted that when it was looking to put such practices in place under a recent Section 319 grant that several Caroline County horse owners expressed interest (but were not within the eligible watershed for that grant).

   There was also discussion of whether regional-scale manure composting facility would be of interest. There was general sense that there would need to be some incentive to offset the cost of hauling manure to such a facility.

   There were also questions about what is the best way to manage manure from horse/small farms (i.e., is spreading composted manure on fields a best practice?). Participants asked about the best ways to manage manure, and requested that DEQ provide information on recommended best practices for manure management.

2. **Cover Crops**: One participant expressed interest in greater support for use of multi-species cover crops, which provide higher amount of absorption than single-species or hay, and effectively address erosion. The estimated cost is about $20 more per acre than single-species cover crops. Currently $48/acre is the top reimbursement rate available for cover crops. These funds are also over-subscribed, with about double the amount of cover crop applications submitted than funding available.

   There was discussion that conservation uses of farmland may be attractive to some, since many agricultural landowners no longer own equipment to bail hay. Both permanent cover crops that are not bailed for hay and reforestation could be of potential interest. There also was interest in more support for soil testing on cropland to determine reasons for poor plant growth – the amount (density) of testing that is normally provided is not sufficient to address all needs.

3. **Reforestation:** One participant asked whether landowners who have harvested forest are responsible for the cost to replant trees. The Dept. of Forestry (DOF) representative noted that it is up to the landowner whether they want to replant trees following forest harvesting operations, and explained that DOF has funding to support replanting pine trees – this is their Reforestation of Timberlands program. For landowners interested to plant hardwood, NRCS has conservation programs that can provide funding support. DOF also has a program for planting trees in riparian buffer zones.

   One participant observed that adding areas of trees to existing fields and/or reforesting open lands may also have the benefit of helping to disperse wildlife. Financial incentives to reforest areas in agricultural uses would be critical to having any productive lands planted in forest.

Bio-Solids: The topic that got the greatest amount of discussion was Bio-Solid applications in the area, which is an issue commonly raised to Caroline County in citizen complaints.

The Hanover-Caroline SWCD representative explained the two types of Bio-Solids that are used locally. Class B Bio-Solids are delivered to agricultural producers in large volume (truckloads) and require a permit from DEQ to be applied. Permits specify storage and use requirements such as dry storage area, set-backs from streams, and timely field application following delivery.

Class A Bio-Solids are pelletized, sold commercially, and are not subject to permits. They do not have the type of storage and use requirements as Class B, so they are more likely to be stockpiled for longer periods than Class B solids. Both classes of Bio-Solids have been subjected to heat treatment/ composting that removes bacteria. Nonetheless, participants noted that many people believe bio-solids could be a source of bacteria contamination. There was commentary that when bio-solids are not applied quickly there may be potential for bacteria levels to rise, and on occasion stockpiled bio-solids have caught fire.

One participant noted that a West Point paper mill produces a by-product that is treated as a Class A (not permitted) Bio-solid and is broadly spread in the King and Queen County area of the watershed. Some participants said this product has a particularly offensive odor. One of the other participants has used this product frequently, and said it has no significant odor if applied quickly after delivery, and that its greatest nutrient value was for calcium. He observed that since Class A solids are not subjected to permit requirements, they have more commonly been stockpiled on-site for longer times than Class B solids.

Public information/education on Bio-Solids should be a part of the Mattaponi IP, as well as composting and manure management practices. More generally, there would be value to have the plan help inform non-agricultural residents about the agriculture sector. Dr. Ebanylo of Virginia Tech was identified as an agricultural bio-solid professional who has conducted previous studies that may be relevant to educating watershed residents. Given the level of public interest and concern with bio-solids, participants recommended the Mattaponi IP discuss their use in some detail.

Wildlife: Wildlife populations in the watershed was another topic discussed.

One participant who has always lived in the area observed that wildlife populations have grown tremendously in recent years, including deer, bear, coyotes and possums. Others observed that wildlife will "eat anything" and have decimated some area crops, including soybeans and alfalfa.

The Farm Bureau representative noted that they (FB) have tried for many years to have an agricultural producer appointed to the Department of Game and Inland Fisheries (DGIF) Board of Directors. One participant shared a perception that DGIF being funded by hunting revenues, and directed by hunters, could serve to bias their consideration of potential actions to address wildlife overpopulation.

Bacteria Source Tracking: Related to the large wildlife population in the Mattaponi watershed, there is interest among workgroup members for DEQ to utilize bacteria DNA source tracking analysis to inform development of the IP. DEQ noted that notwithstanding declining costs of this analysis, DEQ is not able to perform bacteria source tracking with the funding resources it has available.

Discussions of this issue included the possibility that area universities might have source tracking capabilities that should be explored. A participant suggested having wastewater treatment utilities help determine spikes in bacteria levels in residential sub-divisions through regular bacteria monitoring. It was recommended that targeted source tracking in a few sub-watersheds should be included as part of the Mattaponi IP.

Dog Kennels/Hunt Clubs: There was also discussion of kennels by landowners and hunting clubs in the area. It was noted that they are generally located as far away from neighboring residences as possible and that cages are placed on concrete flooring and in "high and dry" areas. Local jurisdictions require a permit when five or more dogs are located on the same property, so identifying kennels should be feasible.

Representatives of the SWCDs expressed interest to learn more about what might be feasible to improve environmental management of kennels, and DEQ committed to share information provided by participants in the 2017 Upper Goose Creek IP development.

Steering Committee Representatives: DEQ requested volunteers to participate in the Steering Committee that will review and comment on the draft Mattaponi Implementation Plan. Stuart Lane expressed interest to serve on the Steering Committee. Others will be needed and DEQ will follow up to identify additional Steering Committee representatives.

Next Steps in IP Development: A Residential Workgroup meeting will be held in mid-December to discuss residential septic, stormwater management, and pet waste aspects of the IP. The current schedule calls for a draft plan to be ready for Steering Committee review in spring 2019, with a goal of having a final IP ready to submit to EPA for approval in summer 2019.

D-4: Residential Workgroup Meeting in Ruther Glen - January 9, 2019

Mattaponi TMDL Implementation Plan:

Residential Workgroup Meeting

January 9, 2019

The Mattaponi TMDL Implementation Plan (IP) Residential Workgroup met on Wednesday, January 9, 2019 from 1:00 pm – 3:00 pm at the Caroline County Public Library, Ladysmith Branch, at 7199 Clara Smith Drive, Ruther Glen, VA.

Attendance

Seventeen (17) individuals, including three Department of Environmental Quality (DEQ) staff and a member of Streams Tech., Inc. (DEQ's contractual support) participated in the meeting. Participants are listed alphabetically below:

1. Tony Ayers, Virginia Connection
2. Ben Bradley, Stantec, for VA Dept. of Transportation
3. Kevin Byrnes, Regional Decision Systems LLC
4. Sayedul Choudhury, Streams Tech., Inc.
5. Edie Curry, Caroline County resident
6. Robert Drewry, Virginia Attorney General's office
7. David Evans, Dept. of Environmental Quality
8. Dr. Charles Gowan, Randolph-Macon College
9. Priya Gunduboina, Dept. of Environmental Quality
10. Ken Hardt, Attorney
11. Etta Lucas, Tri-County City SWCD
12. David McIntire, King and Queen County
13. Olivia Mills, Fort A.P. Hill
14. David Nunnally, Caroline County
15. Marta Perry, Tri-County City SWCD
16. David Rababy, Lake Caroline POA
17. Ashley Wendt, Dept. of Environmental Quality

Meeting Summary

The meeting began with participants introducing themselves, followed by an opening presentation by Dave Evans, DEQ's Nonpoint Coordinator for the Northern Regional Office. The presentation summarized the TMDL IP process, summary information and analysis of Mattaponi watershed water quality, identified typical septic system and developed lands best-practices to address bacteria contamination, and the role of the residential workgroup in plan development. There were a couple questions about water quality data: (1) how many samples does DEQ take to make an impairment finding and (2) is *E. coli* the best measure of bacterial contamination? DEQ makes water quality bacteria impairment decisions based on a minimum of 12 samples within the most recent six year timeframe, when >10.5% of the samples exceed the water quality criterion of 235 colony forming units/100 milliliters. And DEQ stated that *E. coli* is the preferred measure of bacterial contamination in streams because it has the best correlation with the presence of the type of bacteria that cause human health impacts.

Two additional speakers presented information to inform workgroup discussions. Kevin Byrnes of Regional Decision Systems, LLC presented septic systems analysis he recently completed to inform the George Washington Regional Commission's Chesapeake Bay TMDL Watershed Implementation Plan, Phase III work with local jurisdictions. Kevin shared (pro bono) with DEQ this detailed, geographically referenced, information on area septic systems' location and maintenance records which has been "cropped" to focus on the Mattaponi Implementation Plan (IP) watershed. The final report of Mr. Byrnes analysis was anticipated to be completed within another week.

Dr. Charles Gowan, a professor of Biological Sciences at Randolph-Macon College, then summarized research conducted by students in one of his applied environmental science classes. Students in his class collected water quality samples from numerous locations in Ashland, VA to identify bacteria hot-spots, and then conducted additional pin-pointed locational sampling/analysis to zero in on pet wastes and sanitary sewer system leaks that proved to be the sources of elevated bacteria levels in local streams. He noted that future student research could contribute to Mattaponi watershed planning and implementation efforts.

Lake Caroline: during the water quality part of the presentation, a participant inquired whether DEQ monitors water quality in Lake Caroline, which is a 277 acre lake in the IP area. DEQ responded that it conducts WQ monitoring of the larger lakes in the Commonwealth, and would respond to this specific inquiry in follow up to the meeting. ***Update:*** *As a privately owned lake, DEQ does not monitor Lake Caroline water quality.* Lake Caroline residents conduct extensive monitoring of lake water, and their Executive Director offered to share this data with DEQ. It was also noted that Lake Caroline has plans to dredge the lake, has received Army Corps approval and is currently awaiting DEQ approval of its dredging plan. DEQ staff offered to follow up internally to identify the status of DEQ's consideration of the dredging plan.

After these presentations, Mr. Evans facilitated a group discussion of several questions included in a handout provided to workgroup members to guide their input to plan development. The specific issues discussed and key points made during the meeting follow:

Septic Systems Discussion: there was a well-rounded discussion of perspectives and ideas for addressing bacterial contamination that comes from septic systems. Key points discussed included:

- In Caroline County, not all county properties with septic systems are subject to the Chesapeake Bay Preservation Act's (CBPA) five year pump-out requirements, because part of the County falls outside of the Chesapeake Bay watershed. Initial efforts to apply the pump-out requirement county-wide were successfully challenged in court, and now the requirement is applied to CBPA's Resource Management (RMA) and Resource Protection Areas (RPA) that are located close to water/wetlands. Written notifications are sent on Year 1 to all RMA/RPA properties, and in subsequent years letters are sent out to homeowners in individual magisterial districts within Caroline County
- CBPA requires homeowner notification of septic system pump-out requirements, but does not require homeowners to repair septic systems that are not functioning properly.
- Lake Caroline has a total of 2,096 original lots, with 1,187 homes in place. All homes are on individual septic systems. The Lake Caroline Owners Association has the ability to levy fees and closely enforces a local requirement to pump septic systems every five (5) years and at the time of property sales. The Owners Association maintains detailed records of septic system maintenance.
- A participant noted that Lake Land-or has a wastewater treatment plant that was built for the community by Aqua, VA. It was stated that user fees are quite high and the owner may have interest to expand its service area as an opportunity to reduce household user fees. Lake Caroline residents are not interested due to current user fee rates.
- The septic data analysis that Kevin Byrnes has compiled has been shared with VDH and all local jurisdictions to enhance their ability to oversee septic system maintenance and to provide justification for State and/or federal cost-share financial assistance to incentivize proper septic system maintenance and repair to help achieve Chesapeake Bay TMDL WIP III and local stream bacterial TMDL goals.
- The Caroline County government participant noted that enforcing septic maintenance requirements at the local level is extremely burdensome/labor intensive for counties with small staffs. Current enforcement measures require a judicial hearing for each case requires a judicial hearing, and the staff workload to prepare for such hearings is substantial. After acknowledging this workload impediment, another participant commented that a select few successful septic maintenance enforcement cases that were publicized locally could lead to improved septic system compliance with CBPA requirements. A Tri-County/City SWCD participant noted that the localities do not have in place enforcement mechanisms such as fines. She affirmed that basic implementation, let alone enforcement, is a challenging task for smaller localities to undertake without additional funding or support.
- Another impediment to septic system maintenance that was raised was perceived tensions between local jurisdiction health departments and the Virginia Department of Health (VDH). Local jurisdictions are reluctant to accept a lead role in septic maintenance – seeing this as VDH's role. There is one General Assembly bill that proposes to return the lead for septic system

notification and oversight from local jurisdictions to VDH in three planning districts. Currently data on septic system inventories and system maintenance is very incomplete, and improved coordination between VDH and local health departments was advocated.

Developed Lands Discussion: Less time was available for discussion of needs and opportunities to address bacteria sources from developed lands. The following points were made:

- The role of Stormwater ponds in bacteria management was raised, and one participant observed they may be ineffective as they often attract geese that could be a source of increased bacteria.
- A participant noted that it would be valuable to conduct new research on the bacteria reduction efficiencies of various stormwater management best practices. There currently is very limited information on bacteria reduction efficiencies for commonly used stormwater BMPs.
- A recently constructed stream restoration project in Ashland includes side-channel constructed wetlands that will divert and retain water during peak flow events. Randolph-Macon students will conduct comprehensive water quality analysis of these wetlands that will include information on bacteria reductions for water retained in the constructed wetlands.
- Residents of Lake Caroline are very concerned for sound environmental management practices given their multiple (recreation and drinking water source) uses of Lake Caroline water. The community's drinking water is a blend of lake and groundwater sources. The biggest environmental concern of Lake Caroline is sediment runoff, which has led to the need for the planned lake dredging project.
- Pet waste discussions included an observation that county license records for pets may be worth analyzing, but the records are incomplete. Another participant suggested it may be valuable to conduct pet waste management outreach to apartment complex residents. Due to their proximity to water, another comment was that lake communities could be the most important area of focus for pet waste education. A participant shared a concluding comment to the pet waste discussion that the IP should definitely include a pet waste component, particularly in jurisdictions with pet leash laws, and there was no dissent to this suggestion.

Bio-Solids: A question was asked whether DEQ believes that bio-solids applied in the IP area may be a source of bacterial contamination.

- DEQ responded that Class A bio-solids, which are products sold commercially that do not require permits, are treated to ensure harmful bacteria levels are not present. DEQ noted that some people believe that long term storage of these products before their application might allow for regrowth of bacteria, but that DEQ is not aware of data that corroborates this concern.
- Class B bio-solids are bulk delivered products that are subject to DEQ-issued permits. DEQ specifies the terms of their storage and use, and these permit conditions are written to avoid negative water quality impacts. DEQ acknowledged that if bio-solids are not stored and applied in a manner consistent with the terms of the permit that water quality impacts could occur.

One meeting participant provided a few additional comments/suggestions in writing at conclusion of the meeting for items to include in the implementation plan..

- DNA testing would be valuable to have more precise understanding of bacteria sources to inform implementation actions.
- Community-based social marketing around pet waste would be an important strategy for creating voluntary changes.
- Funding to assist localities and property owners with managing septic pump-outs and repairs would be valuable to enhance septic system maintenance.

Steering Committee Representatives: DEQ requested volunteers to participate in the Steering Committee that will review and comment on the draft Mattaponi Implementation Plan. While no one volunteered, Mr. Evans noted that he expects that the County and SWCD representatives will participant in the Steering Committee, and a few additional volunteers would be valuable.

Next Steps in IP Development: The current schedule calls for a draft implementation plan to be ready for Steering Committee review in spring 2019. Many times DEQ convenes a Government Workgroup to inform final IP development, and this may or may not be done for Mattaponi; governmental agency workgroup participants will be kept informed of plans for such a meeting. A final Public Meeting will be held, with a 30 day public comment period on the draft IP, to seek public input on the draft plan before it is finalized. DEQ's goal is to have a final IP ready to submit to EPA for approval in summer 2019. EPA approval of the IP will make the plan area eligible for Section 319 Nonpoint Source grant funds from EPA.

D-5: Steering Committee Meeting in Bowling Green - March 27, 2019

Mattaponi River Watershed Implementation Plan

Steering Committee Meeting

March 27, 2019

Meeting Notes

Location: Bowling Green Town Hall

117 Butler Street

Bowling Green, Virginia 22427

Start: 1:00 p.m.

End: 3:00 p.m.

Meeting Attendance:

1. David Evans, VA Department of Environmental Quality (DEQ), Facilitator
2. Sarah Sivers, VA DEQ, Water Quality Planning Team Lead
3. Sayedul Choudhury, Steams Tech, Inc., technical support contractor to DEQ

Steering Committee Members:

4. Barbara Bach, Caroline County, Horse farm owner
5. Benjamin Bradley, Stantec (VA Dept. of Transportation Contractor)
6. Kevin Byrnes, Regional Decision Systems, LLC
7. Stuart Lane, Agricultural producer, Caroline and King & Queen Counties
8. David McIntire, King & Queen County
9. David Nunnally, Caroline County
10. John (Jack) Vanderland, Homeowner, Lake Caroline

General Public: Observers:

11. Eunice Tucker, VCU Student
12. Tim Biddle, Trutta Environmental Services

Meeting Minutes:

Attendees were welcomed and participants introduced themselves. David Evans of DEQ explained the purpose of the meeting and shared general comments about the Mattaponi watershed and factors that are most relevant to development of the Implementation Plan (IP). He then shared information in a powerpoint presentation that served as a foundation for seeking Steering Committee members input on a series of questions about different components of the IP. Participants had received both the discussion questions and the presentation in advance of the meeting to facilitate their contributions during the meeting. During the presentation a few clarifying questions and comments were offered, and are summarized below:

- Funding Needs for the IP: a question was asked whether the cost estimates in the presentation represented new funding needs or cost-share. DEQ responded that the cost estimates are the projected full cost of the Best Management Practices (BMPs) presented. Some recommended practices (e.g., Agricultural BMPs) already have cost-share funding available, and for others (e.g. Residential Septic BMPs), completion of the IP could provide for new Section 319 grant funding to support their implementation.
- Program Administration Costs: another question pertained to whether "overhead" costs to manage the implementation of recommended BMPs were estimated. DEQ responded that the cost estimates shown at this time do not include program administration "technical assistance", but that the full IP report will include these costs.
- Public Comment: there was a question about plans for public comment on the IP report. DEQ responded that a draft IP report is planned to be ready for Steering Committee members to review by the end of April, and the Final Public Meeting is tentatively planned for the first half of June, 2019. A 30 day formal comment period will begin on the date of the Final Public Meeting.
- Local Government Support Letters: one member inquired if letters of support from local jurisdictions in the IP area would be needed. DEQ said the active participation of local jurisdictions and area producers and residents is what is most important to meet DEQ and EPA expectations, and summaries of the public and workgroup meetings document their involvement. Additional letters of support are not needed, nor are they discouraged.
- Bacteria Reduction Needs: a member observed the very high (80%) bacteria reductions shown as needed for pasture, croplands, and developed lands in the Root Swamp watershed, which has a very high percentage of land in forest. DEQ and Streams Tech responded that these percentages (from the TMDL report) are derived based on the water quality monitoring data available, which is limited for this watershed. The timing of monitoring events (in relation to heavy precipitation events) can strongly influence bacteria results. DEQ noted that while BMP recommendations in the IP report will need to be sufficient to achieve the TMDL reduction goals, future water quality monitoring activities will determine whether/when the BMPs implemented are sufficient to achieve the Recreational Use water quality standard.

Most of the meeting time was used to discuss the questions DEQ prepared to elicit input on various components of the IP. The key discussion topics and feedback shared by Steering Committee members follows:

Addressing Newly Impaired Areas

DEQ has modified the IP watershed scope from its original planned to incorporate additional areas in Polecat Creek and a lower section of the Mattaponi River that are identified as "impaired" for excess bacteria in the draft 2018 DEQ Integrated Report. Participants were asked if they have any questions or feedback on DEQ's plans. All participants expressed support for DEQ's plan to develop new TMDL equations to identify reductions needed, and then enlarge the adjacent 2016 TMDL Watersheds (Polecat Creek and Reedy Creek) to incorporate the areas containing the newly identified impairments.

A question was asked as to what the additional costs are for these new areas. DEQ and Streams Tech will follow up on this question and provide the incremental BMP costs for these areas to the Steering Committee. They are expected to be a modest increment of the entire BMP cost estimate of $53 million.

Livestock Exclusion Fencing

DEQ summarized the approach taken to develop preliminary BMP estimates for stream exclusion fencing, and sought input from members. Questions and comments included:

- Stream Set-back Distances: DEQ noted that both 35' and 15' set-back BMPs are included in the preliminary recommendations. Participants discussed how the Chesapeake Bay Preservation Act (CBPA) generally requires 100' buffers from perennial streams, with a reduced set-back of 25' for agricultural lands. It also was noted that Orange County has 50' set-backs required in some zoning districts that are not covered by the CBPA. Discussions concluded that 15' set-backs should only be included for areas not subject to CBPA or other local ordinances requiring greater buffers, so most BMPs should provide for 35' buffers. DEQ also noted that the Virginia Agricultural BMP Advisory Committee is currently making recommendations that will affect the Commonwealth's fencing/buffer cost-share programs, and the report will address this.
- Extent of Fencing in place/needed: There was a question as to what percentage of pastures are current fenced in the Mattaponi watershed. DEQ noted that the local SWCDs have begun to identify cattle operations that are currently fenced and those that are not. A participant suggested that Districts should be able to map areas where fencing BMPs have received cost-share assistance, and there was discussion that privacy protections under many agricultural conservation programs may limit this. Caroline County may be able to assist with mapping, and participants expressed hope that privacy could be maintained while using geographic analysis methods to focus outreach to producers with livestock who currently have access to streams.
- DEQ is considering identifying a subset of watersheds where water quality data analysis indicates greater potential for direct deposition sources of bacteria as priorities for livestock exclusion fencing outreach. The agricultural producer present indicated support for this approach, and DEQ plans to write to this in the IP report.

Pasture Management: comments offered relative to DEQ's questions included:

- There was very limited discussion here, with an inquiry as to whether the fertility of pasture lands is assessed. The point offered was that healthy pastures are better drained and result in less runoff that can carry bacteria to streams.
- A committee member commented that there may be opportunities to improve the bacteria reduction value of existing stream buffers with additional planting of the buffer zone. This comment was well received by others and should be incorporated into the IP report.

Cropland BMPs: The preliminary BMP recommendations include measures for conservation tillage, cover crops, and grassed waterways. Comments offered were as follows:

- It was noted that most cropland in the IP area is currently using no-till farming practices, driven by the fuel cost savings they offer. Cover crops are common, but their planting can be limited by heavy precipitation/wet fields, which was a common occurrence in 2018.
- Existing cost-share programs have been very beneficial and supported increased use of cover crops. The most environmentally beneficial cover is a multi-species mix with inclusion of legumes and clover. Multi-species cover crops are somewhat more expensive, but result in improved soil structure and drainage, and also reduces freezing and allows rain infiltration to reduce runoff during the winter.

Wetlands and Reforestation: DEQ noted that while these measures are often not included in bacteria TMDL IPs, they offer bacteria benefits along with many other ecological benefits. In this light and from local stakeholder interest to include them, a modest amount of these practices will be included in the IP. Discussion points made were as follows:

- While there has been limited private property wetlands restoration work in the watershed to date, the very wet previous year (2018) might result in a greater interest in wetlands restoration in the future.
- One participant asked how an agricultural producer would ever conclude that it is beneficial to take land out of production for wetlands or forest restoration. Relatedly, if the land owner made this decision, a reduced production area would negatively impact a tenant farmer working the land. DEQ noted that cost-share programs might make this viable for marginal agricultural lands, while acknowledging removing lands from production in not often in the producers economic interest.
- This led to brief discussion of the Healthy Forests initiative, which was developed in a partnership by the Virginia Department of Forestry and the Rappanhannock River Basin Commission. The Healthy Forests program was recently endorsed by the Virginia Legislature, and it will provide new incentives for individual landowners and local governments to receive private capital funds associated with carbon markets to support their existing forest preservation and new forest/reforestation efforts. The Mattaponi IP plan should briefly note how this program can support some of the IP's goals.

Horse Farms: With one of the committee members an area horse farm owner, DEQ requested input on its plan to specifically include small farm grazing system and manure composing BMPs for equine operations.

- The feedback shared included helpful background information about horse farming. Horses need to stay out of water, and the amount of local flooding last year raised challenges. Cross-fencing horse pastures and rotating their use every 7 years is a best practice.
- A key point for BMP planning is that horses generate a lot of manure! In this context, the DEQ manure composting specifications seem to be rather small, and it would be helpful to allow for larger composting units. DEQ noted that these specifications have been prepared to enable field application/practical applications, and modifying them to meet individual needs will be possible.
- Discussion also raised awareness of the amount of labor that would be required to remove manure from pasture to a compost area, and there were questions about how realistic this may be. All farming, horse farms included, is extremely labor intensive and increased labor requirements for better manure management will be challenging to carry out.

Residential Septic: DEQ noted the septic BMPs were developed using the detailed analysis prepared by Kevin Byrnes in support of the George Washington Regional Commission's WIP III planning effort, which he shared with DEQ at no cost. DEQ expressed great appreciation for this in-kind support for the Mattaponi IP from Mr. Byrnes. DEQ said that the BMPs in the preliminary chart represent pumping all septic systems once (approximately 15,000) and repairing approximately 20% of systems. The draft IP report will break out recommended septic BMPs into the individual practices (RB-1 to RB-5) that DEQ offers cost-assistance for via Section 319 grants. Discussion included the following:

- Alternative Septic Systems may be undercounted, based on the experience in Lake Caroline. Typically 15-20 new building permits are issued annually in the Lake Caroline community, and nearly all new homes have installed Alternative Systems. DEQ was encouraged to look at whether the data may warrant revision for the Polecat Creek watershed, where Lake Caroline is located. The committee member from Lake Caroline offered to share data on system age within his community.
- Lake Caroline requires pump-out of conventional septic systems by owners every five years, as a community ordinance.
- There was brief discussion of the need for maintenance of septic systems, and that many owners may not adhere to recommended schedules. There was discussion of the use of plastic filter cap additions, which enable less frequent maintenance of (Alternative Systems or all, including conventional?)
- DEQ asked for participants' feedback on how septic system priorities might be identified in the IP report. One possibility would be to indicate septic systems in CBPA designated areas are the highest priority; some committee members expressed a sense that these homes already receive increased attention and that those outside CBPA areas may warrant priority attention under the IP. There was general consensus that the age of septic systems and their location in areas with poorly drained (Group C/D) soils, as well as homes with no record of recent septic maintenance, should be identified as the top priorities for septic outreach and assistance. Increasing/improving homeowner notification of septic maintenance needs is important in the education and outreach component of the IP.

Only a few minutes remained for discussion of recommendations to address Pet Wastes, Stormwater runoff, and acknowledge concern for Biosolids use in the watershed. Take away points from comments shared are:

- Pet Wastes: DEQ noted that while Pet Waste measures will be included in the draft IP, they will be far fewer than shown in the preliminary BMP recommendations tables, given the relatively low development density of the IP area. Participants noted that pet waste stations/composters would be most appropriate in the more concentrated development areas like Bowling Green, Lake Caroline, Caroline Pines, Lake Land or, Ladysmith, and higher density areas in Spotsylvania. The education and outreach program should ensure that effective pet owner information on avoiding water contamination from pet wastes is developed and shared with all local organizations that have newsletters/communications with their members. Local veterinarians will also be important opportunities to share information about pet waste management practices. Finally, it was noted that all homeowners or businesses with more than five dogs are required to apply for licenses in Caroline County (others?) and this information could also help focus attention for improved pet waste management.
- Stormwater Management: DEQ similarly noted that the IP will include some stormwater management practices, though far less than to amount shown in preliminary BMP recommendations table. Comments offered were that, like pet wastes, these measures should focus on the relatively few areas with higher density development. One participant wondered how long pet wastes maintain elevated bacteria levels, and in light of the response that this period could be nearly a month, questioned whether stormwater BMPs would result in a true reduction in bacteria releases to streams.
- Biosolids Education: DEQ noted that in earlier IP workgroup meetings, participants suggested it would be valuable for the IP education and outreach program to give attention to improved understanding of the use of biosolids in agricultural production. Participants support this, while at same time having skepticism as to whether improved public understanding will be achievable for an issue that is emotional for many. The agricultural producer on the committee offered that it would be valuable to have willing local producers who use Class A biosolids (commercially available, no DEQ permit required) have the runoff around their storage areas tested to assess whether bacteria contamination is present, and indicated he would be willing to participate in such testing.

Dave Evans concluded the meeting by thanking all present for their contributions, and informed them that he plans to send a draft IP report for their review at the end of April. This would allow for a 2-3 week review and comment period by the Steering Committee, and time for DEQ to revise the draft report for presentation to the public in an early/mid-June Final Public Meeting.

D-6: Final Public Meeting in Bowling Green - September 10, 2019

Mattaponi River Watershed Implementation Plan

Final Public Meeting

September 10, 2019

Meeting Notes

Location: Bowling Green Town Hall

117 Butler Street

Bowling Green, Virginia 22427

Start: 4:30 p.m.

End: 6:30 p.m. (planned), 6:00 p.m actual end time.

Meeting Attendance:

David Evans, VA Department of Environmental Quality (DEQ), Facilitator

Sarah Sivers, VA DEQ, Northern Regional Office

Ashley Wendt, VA DEQ, Central Office

Sayedul Choudhury, Steams Tech, Inc., technical support contractor to DEQ

David Nunnally, Caroline County

Frank Adams, Chief, Upper Mattaponi Tribe

Marta Perry, Tri-County, City Soil and Water Conservation District

Mariya Hudick, Tri-County, City Soil and Water Conservation District

Suzanne Dyba, Stantec (VA Dept. of Transportation Contractor)

Pat Vanderland, Homeowner, Lake Caroline

John (Jack) Vanderland, Homeowner, Lake Caroline

Stuart Lane, Agricultural producer, Caroline and King & Queen Counties

Barbara Bach, Caroline County, Horse farm owner

Lynwood Broaddus, Agricultural producer, Caroline County

Edith Curry Broadhead, Caroline County resident/property owner

Diane Skinner, citizen – Lake Anna

Ron Skinner, citizen – Lake Anna

John Harmon – citizen

Robin Didlake, citizen, teacher Caroline County High School

Mike Parker – Quality Grounds

Holly Beazley, student, Randolph-Macon College

Elizabeth Christeller, Mattaponi-Pamunkey River Association

Meeting Minutes:

Dave Evans of DEQ welcomed attendees and opened the meeting with a brief overview of the Mattaponi Implementation plan (IP) project, and its context. He introduced himself and had meeting participants introduce themselves. Dave then presented a short slide show summary of relevant background and the recommendations contained in the draft Mattaponi IP report, taking questions and comments along the way, and additional input at the end of the presentation. Copies of the presentation slides and a summary ("public report") of the IP technical report were provided to participants. The draft technical report is being posted to DEQ's website for formal public comment.

A summary of the clarifying questions and comments from meeting participants during the presentation follows:

- Water Quality Impairments: A question was raised about whether there were water quality concerns (impairments) other than bacteria in the Mattaponi River watershed. DEQ responded that, while the IP focuses on bacteria impairments, there are several additional stream segments that are designated as impaired for other pollutants. Other pollutant impairments in the IP project area are associated with the aquatic life and fish consumption water quality standards, due to low dissolved oxygen, pH, and benthic community impacts, and the presence of elevated mercury in some stream segments.
    - Following DEQ's summary of the bacteria levels and frequency that the *E. coli* criterion (235 cfu/100mL) was exceeded in the impaired streams, a question was asked as to why Doctor's Creek and another station showed higher bacteria levels than others. DEQ responded that it does not have sufficient information to precisely identify the reasons behind such differences, and DEQ's contractor summarized the analysis of existing data that was done during TMDL development. The IP report and its underlying analysis provide some important information to consider, but additional "on-the-ground" work will be need during implementation to pin-point specific sources of bacteria releases and identify opportunities to address them. DEQ explained that once the IP is approved by EPA, the area will be eligible for Clean Water Act (CWA) Section 319 Nonpoint Source grants that can fund detailed reconnaissance work, and provide cost-share assistance for recommended best management practices (BMPs).

- A participant asked if the bacteria of concern are from mammals/humans, vs. more diverse sources. DEQ clarified that *E. coli* bacteria are from warm-blooded animals, including mammals/humans as well as birds.

- Agricultural BMPs: During DEQ's presentation of recommended Agricultural BMP's, a question was asked as to whether the presentation summarized BMPs that have been implemented, or additional measures needed. DEQ clarified that the BMP summaries in the presentation were of the (additional) measures needed to reduce existing sources of bacteria by the amounts needed to meet recreational use water quality standards, and allow for the impaired streams to be "delisted". DEQ acknowledged that many Agricultural BMPs have already been implemented in the project area, and observed that in 2019-20 the Virginia Agricultural Cost Share (VACS) program provides for 100% cost-share for Livestock Exclusion Fencing systems that have a 50 foot buffer set-back from the stream.
- Residential Septic BMPs: During presentation of the residential septic BMP recommendations, a question was asked about the recommendation for nearly 15,000 septic system pump outs. DEQ had stated that there are some 17,000 residential septic systems in the IP project area. The questioner was curious if his interpretation that this meant that about 85% of existing systems required pump outs was correct. DEQ clarified that while this was the amount/share of pump outs needed to meet the bacteria reductions sought from residential septic systems, it was derived from water quality modeling as opposed to inspections of individual systems.
    - This lead to additional comments and discussion on septic systems maintenance. A participant noted that the Chesapeake Bay Preservation Act (CBPA) requires homeowners to have their systems pumped every five years, but that oversight of this is not occurring. Another participant noted that about ten years ago septic pumping companies were required to report their work, and identify any failing septic systems to the county, but that their reporting was inconsistent and now seems not to be done at all. DEQ observed that the Virginia Department of Health (VDH) and local staffing resources to oversee septic system maintenance are limited, and the need to strengthen this function has recently been noted in the context of Virginia's Chesapeake Bay TMDP Watershed Implementation Plan (WIP) development. Caroline County's participant stated that Delegate Hodges has introduced legislation to strengthen VDH's oversight role, and a study is underway. DEQ noted that approval of this IP will make the area eligible for Sec. 319 grant assistance that can support education and outreach, and assistance to improve septic system maintenance.
    - A question was asked as to how DEQ derived its estimates of the number of septic system pump outs, repairs, new systems, etc. would be needed – were they guesstimates or based on system assessments. DEQ explained that the number, age and type of septic systems were very precise as a result of analysis that Kevin Byrnes completed in 2018 to support the George Washington Regional Commission's input to the Virginia WIP III plan. This data was then used in water quality modeling to determine the amount and type of residential septic BMPs that would meet the needed bacteria reductions from septic systems in each IP watershed. During implementation of the plan, Section 319 grants can support direct outreach to septic system owners to more precisely determine septic system maintenance needs.
    - A follow up commenter observed that there is no requirement under the CBPA to address septic system failures, only to pump out systems every five years. He asked if Section 319 grants could close this gap. DEQ responded that only the most egregious cases of septic failure that result in direct releases to surface waters can be addressed with existing legal authorities, but that Section 319 grants can provide for general education and outreach, and direct engagement with system owners. Communicating the financial and

technical assistance that is available, including up to 80-90% cost-share for septic system BMPs for those with the greatest financial hardship, is a key benefit of Section 319 grants that leads to improved septic system maintenance.
    - Another participant shared a perspective that some area residents have such limited finances that anything less than 100% cost-share would not likely entice them to address a failing septic system. From her perspective, if 100% cost-share can be offered to agricultural producers, it would be appropriate to offer the same financial support for septic maintenance to homeowners in the greatest financial need.
- Developed Land BMPs: During discussion of BMPs to address stormwater runoff from developed lands, a question was asked as to whether the Virginia Stormwater Local Assistance Fund (SLAF) could be used to meet regulatory requirements (under Municipal Separate Storm Sewer System, MS4, permits)? SLAF funding can be used to meet local government's stormwater management requirements (contained in MS4 permits), and another participant noted that most SLAF funding to date has gone to regulated local governments.
    - There was discussion that additional and more predictable levels of SLAF funding are needed to support small local government's ability to implement improved stormwater management retrofit projects.
    - A participant also observed that the cost of stormwater management for new construction effectively impedes economic development in small communities, because many businesses are unable to afford the additional costs.
    - The Tri-County, City (TCC) SWCD participant shared information about the Virginia Conservation Assistance Fund (VCAP) administered by the SWCD. This program, though it has limited funding, can support rain gardens and other related projects to address stormwater runoff. While previously limited to the Chesapeake Bay region, it now is available throughout Virginia.

DEQ concluded the presentation by showing a series of questions it sought feedback on from meeting participants. The following additional discussion occurred at the end of the formal presentation:

- A participant inquired as to whether a single entity, ideally DEQ, could administer a Section 319 grant for the entire Mattaponi IP watershed. DEQ responded that while it may be possible to award a single grant for the entire IP watershed, under current program parameters it would be disadvantageous, and that DEQ would not manage a Section 319 grant directly (because DEQ administers the Statewide Sec. 319 program). A key disadvantage of a single grant for the entire IP watershed is that current DEQ program operations (as explained in the 2020 Request for Applications, RFA, which is active now) have an upper limit of $400,000 on individual Sec. 319 grants. Given the size of the IP watershed, and amount of BMPs recommended to address impaired waters, a single grant of $400,000 every two years would not enable as much progress meeting the IP goals as multiple grants. Given there are three SWCDs, and portions of five counties in the IP watershed, it would be desirable to have more than one eligible party apply for Section 319 grants to enable more rapid progress in restoring area water quality.
- The Caroline County representative observed that managing grants is challenging/demanding for small local governments and commented that centralized grant administration would be advantageous. DEQ noted that it is possible for more than one entity to be included in a single grant, with one the primary grantee and the other(s) being sub-grantees.
- A meeting participant inquired whether local governments can supercede State requirements for septic system oversight. DEQ initially replied that local governments can enact requirements

more demanding that those that apply statewide, but then observed that there are limitations on local authority to do so. Another participant observed that there are in fact many cases where the Virginia General Assembly has limited the ability of local governments to enact stringent local requirements.

- A participant observed that much of the IP watershed streams are not shown as impaired and asked about this. DEQ explained that its data is limited and most areas not shown as impaired do not have sufficient data to make a water quality assessment determination. DEQ also noted that there are additional DEQ monitoring stations with limited data, and promised to share all the bacteria data it has with the TCC-SWCD.
- There was discussion of how wildlife are included and addressed in the IP, in relation to bacteria from pets. DEQ explained that they are analyzed separately, and that Pet Waste BMPs focus on dogs, with education and outreach, pet waste bagging stations, and composter/digester practices recommended. With regard to wildlife (mammals, ducks and geese), their bacteria contributions were determined using wildlife population estimates and modeling techniques during the TMDL. There are not BMPs specifically designed to reduce wildlife bacteria from reaching streams, however the pasture and cropland BMPs, and stream buffers created with stream fencing serve to reduce bacteria reaching streams via runoff, and any wildlife sources of bacteria would be indirectly reduced in that way.
- A meeting participant stated that most wildlife travel along stream corridors, and disagreed with DEQ's statement that fencing BMPs could indirectly reduce bacteria reaching streams from wildlife. Another participant observed that geese are often present in corn and wheat fields in great numbers, and thought these areas could be sources of wildlife bacteria.
- A meeting participant noted that during geese hunting season, migratory geese are limited to 1 bird/day, while hunters can take 10 non-migratory geese daily.
- In the context of discussing the benefits of riparian buffers, a meeting participant shared her understanding that buffers are already required under the CBPA. DEQ agreed that this is true, while noting that not all of the IP watershed is subject to the CBPA requirements (which focuses on areas east of Interstate 95, and adjacent to perennial streams).
- There was a question about why Livestock and Pasture BMPs were separated, and Pasture and Cropland BMPs combined. Pasture and Cropland conservation measures have elements in common and DEQ chose to combine them to simplify their presentation in the IP report.
- A student from Randolph-Macon College (R-MC) inquired about the limited locations of DEQ's monitoring, and asked if it would be valuable to have additional water quality monitoring conducted along smaller stream segments throughout the watershed. DEQ expressed its full support for additional monitoring, and informed participants that a R-MC Fall 2019 seminar class would be conducting additional water quality monitoring and analysis in the Po and Matta IP watersheds. The information they develop can help inform future implementation efforts, by better pinpointing areas with the highest and lower bacteria reading, enabling more targeted identification of bacteria sources and conservation opportunities.
- A Caroline County High School teacher mentioned her interest to work with her science class to conduct supplemental water quality analysis as well. DEQ noted that it has the ability to provide technical and limited financial support for voluntary monitoring efforts. DEQ also noted that Section 319 grants can support additional water quality monitoring efforts to help identify conservation priorities and assess water quality responses to BMPs.

Following completion of the discussion summarized above, DEQ highlighted the next steps for water quality management for the Mattaponi River watershed.

- DEQ will prepare and share notes from the September 10 meeting with participants, including the link to the draft IP technical report.
- Public comments on the IP report will be accepted in writing (to Dave Evans at David.Evans@deq.virginia.gov, or mailed to 13901 Crown Court, Woodbridge, Virginia 22193) through **October 11, 2019**.
- Following review and revision of the report to address public comments, DEQ senior managers will review and approve the IP for submission to the EPA for their approval.
- DEQ will address any comments from EPA and the final report will be approved by EPA to establish Section 319 grant eligibility for the Mattaponi IP watershed.
- DEQ and future Section 319 grantees will monitor progress in carrying out the IP and assess water quality changes. If needed, revisions to the plan can be made in the future based on observed progress achieving its goals.

The IP technical report can be found at the following web location:

https://www.deq.virginia.gov/Portals/0/DEQ/Water/TMDL/ImplementationPlans/Drafts/Matt_IP_DraftTechReport_20190903.docx?ver=2019-09-04-172001-643

Appendix E: Summary of Changes Made to Draft Report

While DEQ benefited from extensive public participation and input throughout development of the Mattaponi Implementation Plan, no comments were received from the public following either the July 24 and 31, 2018 initial public meetings, or the September 10, 2019 final public meeting. The public comment period following the initial public meetings was open from July 31 to August 30, 2018, and that following the final public meeting, for comments on the draft Mattaponi IP report was open from September 11 – October 11, 2019.

Following the posting of the draft IP report for public review, DEQ continued to review the report internally to improve the clarity of its presentation and explanatory text. There were numerous fine-tuning revisions made, while the substance of the report was not altered from that presented to the public for review and comment.

A summary of changes made to the final draft report presented to the public that are reflected in this final report follows:

- Added a new Acknowledgements page and Executive Summary to the beginning of the report.
- Clarified in Section 1 that the 2016 TMDL assigned bacteria reduction allocations to the following sources: developed land, pasture, hay, cropland, cattle direct deposition, and failing septic systems.
- Added the 12-digit federal hydrologic unit codes and the 6th order Virginia NWBD codes to Table 3-1 in Section 3.2 of the report. Also revised Figure 3-1 in this same section to portray the original TMDL watersheds that were folded into downstream watersheds to form the 8 IP watersheds.
- Removed references and data on cat populations in Tables 3-16, and 3-17 and added clarifying text to Section 3.4.6 to explain that pet waste BMPs are focused solely on dogs.
- Revised titles of Figure 3-13 and Table 3-20 to clarify that “existing conditions” referred to data from 2012 included in the TMDL report analysis. The only exception is for the Polecat and Reedy Creek IP watersheds, which were enlarged to encompass new impaired stream segments, which is explained in Table 3-20, footnote #1. Table 3-21 was revised to clarify that failing septic systems (as well as “Cattle Direct Deposition”) were targeted for 100% reduction in the TMDL.
- Text in Section 3.5 was revised to clarify that BMP recommendations were developed that achieve both the geometric mean and the maximum assessment criteria, to satisfy DEQ and EPA expectations for TMDL implementation plans.
- A summary of the final public meeting was added to Section 4.5
- A correction was made to the average cost of equine manure composting BMPs in Tables 5-2 and 5-6 in Section 5. The cost of this BMP was corrected to $3,000 (from $20,000) and appropriate revisions were made to equine BMP cost estimates.
- Clarifying text was added to Section 5.1.1.2 to explain better how the Chesapeake Bay Preservation Act’s riparian buffer requirements may affect allowable livestock exclusion fencing BMPs in the IP project area.
- A new table was created (Table 5-5) to show the type and amount of agricultural BMPs that were installed in the IP watershed from 2012-18 with brief explanatory text was added to Section 5.1.2.
- New text was added to Section 5.4 to clarify that technical assistance funding provided by DEQ through Section 319 grants is competitively awarded through evaluation of responses to an annual request for applications.

- The data in Table 6-1 in Section 6 was revised to be presented in whole dollar amounts, for consistency with other financial data in the report. Also, pet waste BMP costs were moved from the Residential Septic BMPs column to the Developed Lands BMPs column. This previous error was highlighted to the public at the September 10, 2019 final public meeting.
- Additional text was added to Section 7 to more thoroughly discuss the benefits that are expected to be associated with implementation of this plan.
- Table 8-3 in Section 8 was revised to remove the Phase II BMPs for the Reedy Creek IP watershed. Water quality modeling shows that the Phase I BMPs will be sufficient to achieve both the geomean and maximum assessment criteria for Reedy Creek. Accordingly, the costs for Reedy Creek and the entire plan, shown in Table 8-2 were lowered to account for the removal of Phase II BMPs for Reedy Creek.
- Revised text is included in Section 11.1 to more completely explain Virginia's Chesapeake Bay TMDL WIP III plan and discuss how this local TMDL IP and Virginia's WIP III provide co-benefits at local and regional scales.
- Section 12.11 was revised to note that in addition to the BMPs included in the Mattaponi IP report, BMPs identified in Table 3 of Chapter 8.3 in Virginia's Phase III WIP III document that will result in nutrient and associated sediment reductions both within the Mattaponi watershed and the York River Basin will be considered for funding under the Section 319 grant program.
- The titles of several figures and tables in the report were revised to more clearly summarize the information they presented.
- Summaries of the public, workgroup, and steering committee meetings held during development of the Mattaponi IP report were added to Appendix D.